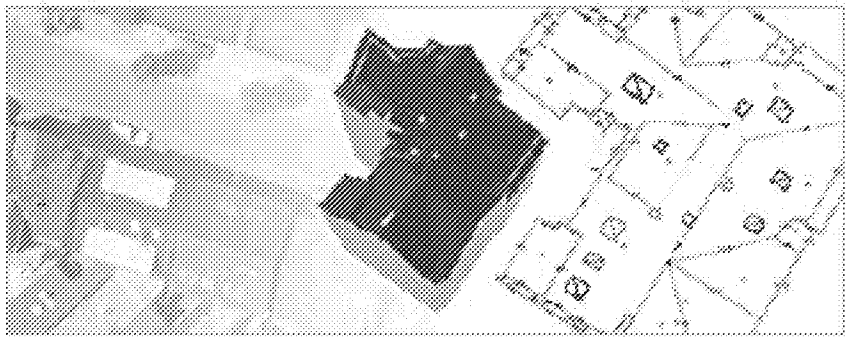
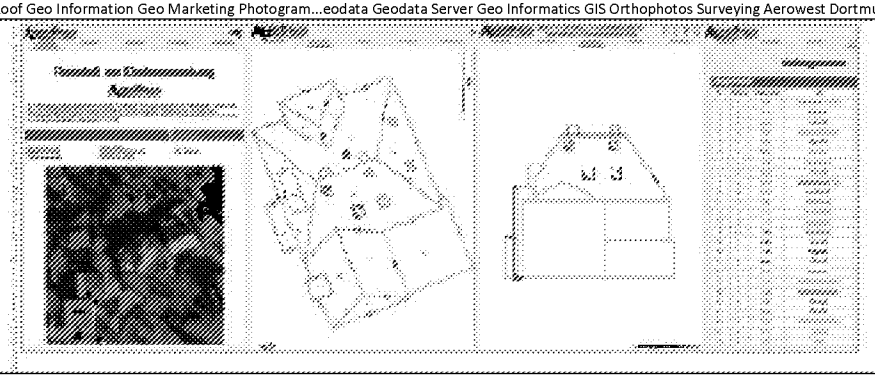
INTERNET ARCHIVE
http://www.aerowest.de/aerodach.html
24 captures
4 Feb 05 - 28 Feb 08
OCT JAN FEB
1
2006 2007
Close
Help

GEODATA SERVICE

AEROWEST GMBH

Geodata login:	**AeroDach – Patented Roof Dimensions**	**Geodata Services**
User name:	AERODACH *online*	
Password:		
Go!		
» **New registration**		**Lena's Construction Trailer**
Geodata online		An innovative marketing concept for LBS West
Geodata server **Geodata services** **Aerodach** **Pricelist**		» **more** LBS
Services	Enter the address, select the buildings and within only two days, you will have the pertaining roof dimensions – as the result of a simple mouse click.	**Turbo Race Bochum**
Photographic image flights		3D race in virtual Bochum as a tradeshow event
Orthophotos		» **more**
Aerial photograph analysis		**Property GIS**
2D Geodata	With the patented AeroDach® roof dimension process, quantity determination is easier than ever. By using qualified surveying, complete roof plans are modeled and summarized.	Area administration with digital Geodata
3D Geodata	Delivery is made by email and contains:	» **more**
As of 09-01-2005	▪ 1 aerial photograph ▪ 1 plan view to scale ▪ 4 layouts ▪ 1 measurement protocol for all lengths, roof surfaces and roof pitches ▪ 1 3D dataset for CAD use (DXF)	
30cm Orthophotos --- **400 cities**		

2124
Pictometry EX2002 (Part 10 of 13)
Roofr v. Pictometry
IPR2023-00436



By using AeroDach®, significant expenses and risks that are incurred during roof inspections by builders, architects or roofers are eliminated. Even within the scope of surveys, the patented AeroDach® process has already been used and judicially accredited.

We would be happy to answer any questions you might have. Please call us at:
AeroDach Hotline +49 (0) 231-557121-26

Current pricelist and sample dataset:

sample.exe		sample.zip	
pricelist.pdf		dataformat.pdf	

Top of page | **Back** | **Print Page** | **Site Map** | **GBC** | **Publishing Details**

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http://web.archive.org/web/20060101021543/http://www.aerowest.de/aerodach.html (2 of 2) [3/25/2012 10:16:45 AM]

AERODACH®
online

Roof Analysis

Standard Delivery Format
and
3D Dataset

Version as of 00-01-2002

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Managing Directors: Ralf Benfer, Hans Joachim Benfer

Standard Scope of Delivery

A standard delivery consists of a self-extracting compressed ZIP archive that is sent by email. After extraction into the AeroDach delivery register, the delivery is on the target computer in HTML format.

Translator's note: Screenshots illegible.

The HTML format makes it possible to view the aerial photograph, the plan view, layouts, measuring protocol and calculation by using an Internet browser.

No special hardware or software is needed!

Retrieval of a dimension is accomplished by using the file START.HTML. The HTML document can be navigated by using links in a menu bar.

Translator's note: Centered headings within screenshots:

Printout of Roof Analysis Measurement Results

Remainder of screenshots illegible.

All graphic representations of the HTML delivery are contained in the folder IMAGES in the form of digital image files. The 3D dataset is located in subfolder 3D.

The HTML pages are optimized for printing on DIN A4 paper. For larger buildings, the plan view is segmented onto several pages to ensure that the printout is true to scale, as produced by standard printers on DIN A4-sized paper. A plan view is divided into a maximum of 4 partial files P1-P4. The root registry of the delivery also contains a plan view grid file by the name of PLANVIEW.GIF, which contains the undivided plan view.

The file PROT.HTM contains the true lengths, surfaces and pitches of the roof surfaces and superstructures of the roof that has been requested. Chimneys, skylights and neighboring buildings are shown, but as a rule, they are not a component of the list of measurements.

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AeroDach Viewer

Upon request, we provide an AeroDach HTML Viewer free of charge.

As an offline browser, it also makes batch-controlled printing of all HTML pages possible upon one mouse click, in contrast to standard Internet browsers. For this purpose, each delivery contains a file named PRINT.BAT in the root registry.

In addition, it makes exporting HTML pages into WORD and EXCEL possible.

AeroDach Viewer – [C:\AeroDach\821398
A File Extras Window Help

AERODACH
online

Cover sheet Plan View

3D Data Format

The AeroDach 3D data format consists of a standard exchange data format and two summary files. This makes importing via a DXF interface possible as well as the complete reconstruction of the roof structure that has been measured.

Thus, an interface is provided for software that is used for subsequent processing of roof geometries, which makes consistent importing of the roof surfaces that have been analyzed into the data processing system of a corresponding import module possible.

For this, the DXF data are structured in layers in such a way that all surfaces in the protocol can be identified in the "Measurement Results of the Roof Analysis". The protocol is transferred as complementary text file so that a complete node-edge model of the outer skin of the building is formed.

DXF is a widely used data format that can satisfy demands of this type. It can be processed directly by almost all graphic software, or at least imported. Further, many free viewers are available, which offer any user a 3D view of his data without any additional software.

Finally, DXF is structured simply and is well documented so that developers can also program corresponding import routines without much effort.

The AeroDach roof dimensions are identified by a version number. This version number is used uniformly in the standard delivery and in the 3D dataset. Changes in the data format are disclosed.



Seq. no. of the change or update of the standard HTML delivery	Seq. no. of the change or updates of the 3D data delivery	Year of the last documented change

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3D Geometry

In the 3D DFX structure, a building is comprised of the total of all flat roof and wall surfaces. These form the outer skin of a body that is hollow in the interior (surface model) in contrast to a 3D solid model.

In the DXF format, these surfaces are modeled as 3D polylines that consist of at least one main polygon and can additionally contain several island polygons (holes, e.g. for roof superstructures) on the same layer.

Each roof surface that is to be summarized thereby lies on a separate layer, which identifies and also classifies. For all other surfaces (walls, windows, chimneys and ventilators) a respectively uniform layer is established (only for classification).

The unambiguous name of the layer of the surfaces to be summarized constitutes the 1:1 linkage with the technical data in the surface file by the name of "areas.asc" (see technical data). There is no redundant storage of the line and/or edge geometry in the DXF file. The initial and end coordinates of the edges with which the connection between the technical data and the geometric data can be established are stored directly in the summary file by the name of "lines.asc".

Note:

The measurement derived from aerial photographs always refers to the exterior form of the roof. Conclusions related to the substructure and/or resets to such are not a component of the measurement or the delivery.

Roof overhangs or the dropping back of rising masonry are not modeled. In the case of roof surfaces of dormer windows or superstructures, this leads to an omission of roof surfaces that are covered by roof overhangs in the measurements that are summarized.

Skylights and chimneys are generally disregarded in the measurements taken by AeroDach. Superstructures and dormer windows are generally taken into consideration as holes in the roof surface.

Technical data (summary), and linkage with the geometry.

The geometric data are interlinked with the additional results of the analysis.

These are two ASCII files (unformatted, with comma separators). Their content and structure will be explained briefly in the following paragraph. With the exception of the layer descriptions (string), all other data is numeric.

The following layers are currently taken into consideration:

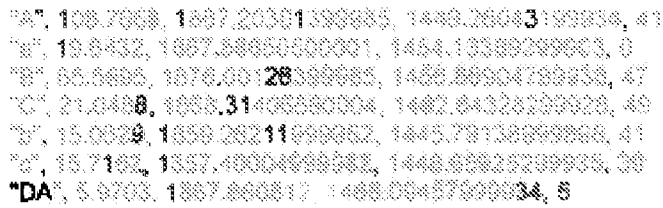
MAIN_<name>	main roof surfaces
ADJACENT_<name>	surfaces of adjacent buildings (adjoining buildings, garages or the like)
SUPERSTRUCTURE_<name>	dormer windows, superstructures
WALL_<name>	fire walls, gable walls, attic
NEIGHBOR	neighboring building parts (are not included in the measurements)
CHIMNEY	chimneys, chutes or the like
WINDOW	skylight
VENTILATOR	position standard ventilator
WALL	house walls

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Total of surface area: “areas.asc”



Each line contains the data of one roof surface:

1. Name of surface
2. Dimension of surface in m^2
3. Coordinates of the center of the surface = text position in the plan view (x, y)
4. Roof pitch in degrees, rounded

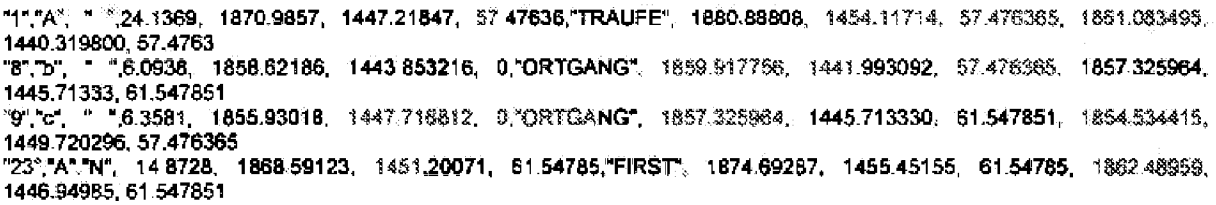
The connection with the geometry is established by using the surface name, which is a component of the layer description.

A..Z, AA..ZZ → Main roof and surfaces of adjacent buildings

a..z, aa..zz → Dormer windows and superstructures

B1.. B99 → Walls and roof weatherings (firewall, attic, ...)

Sum of lines: “lines.asc”



Each line contains the data of one roof surface edge

1. Name of line
2. Description of the 1st abutting roof surface
3. Description of the 2nd abutting roof surface or “ “ for abutting walls
4. Coordinates of the central point = text position in the plan view (x, y)
5. Height above the reference point (only for horizontal lines)
6. Function of the line
7. Coordinates of the initial point (x, y, z)
8. Coordinates of the end point (x, y, z)

The connection with the geometry of the surface model in the DXF file is established by using the coordinates of the initial and end points.

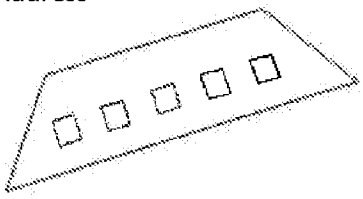
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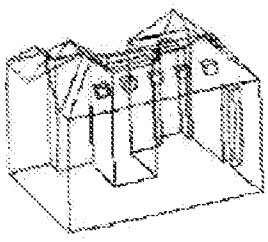
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AEROWESTGmbH Logo
Examples:

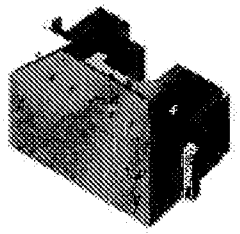
1) Roof surface “MAIN_A” with islands in the DXF viewer
Each roof surface lies on its own layer

Autodesk Volo View Express – [D:\Aerod	Layer
File Edit View Tools Window Help	Name One
Address 	SUPERSTRUCTURE_h SUPERSTRUCTURE_i WINDOW MAIN_A MAIN_B MAIN_C MAIN_D MAIN_E
Ready	

2) Buildings with superstructures and walls Layer name: <class>_<id>

Autodesk Volo View Express – [D:\Aerodach_test\geo.dxf	Layer
File Edit View Tools Window Help	Name One
Address 	MAIN_L MAIN_M MAIN_N CHIMNEY VENTILATOR ADJACENT_DA ADJACENT_DB WALL
Ready	

3) Building shown with color coding of the layer class



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AERODACH® online

Dachauswertung

Standardlieferformat
und
3D-Datensatz

Version 01.00.2002

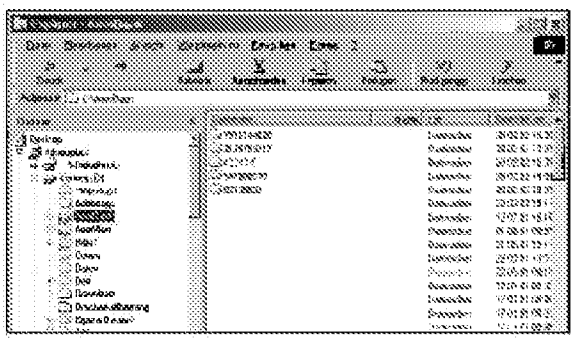
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44135 Dortmund

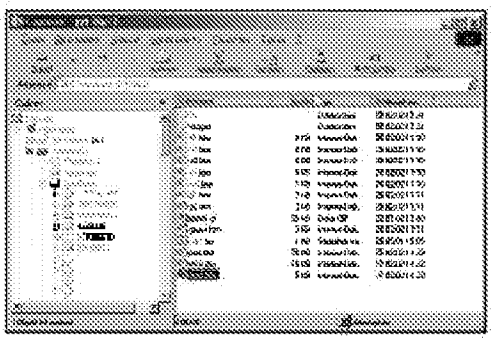
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Standardlieferumfang

Die Standardlieferung erfolgt als selbstextrahierendes komprimiertes ZIP-Archiv via e-mail. Nach Entpacken in das AeroDach Lieferverzeichnis befindet sich die Lieferung im HTML-Format auf dem Zielrechner:



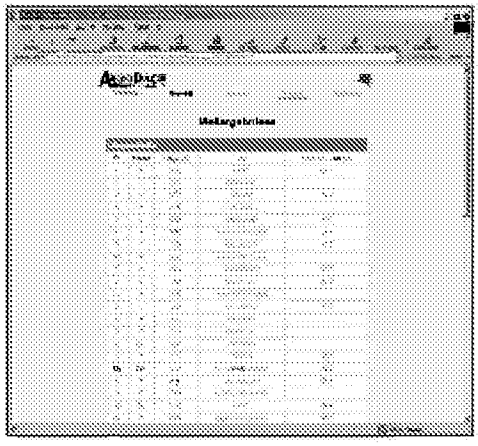


Das HTML Format ermöglicht die Betrachtung von Luftbild, Grundriß, Aufrissen, Meßprotokoll und Rechnung mittels Internetbrowser.

Es wird keine besondere Hard- oder Software benötigt !

Der Aufruf eines Aufmaßes erfolgt über die Datei START.HTML. Die Navigation innerhalb des HTML Dokumentes erfolgt durch Links in einer Menüleiste.





Sämtliche Grafiken der HTML Lieferung sind in Form digitaler Bilddateien im Ordner IMAGES enthalten. Der 3D-Datensatz befindet sich im Unterordner 3D.

Die HTML Seiten sind optimiert für einen Ausdruck auf DIN A4. Bei größeren Gebäuden wird der Grundriss auf mehrere Seiten aufgeteilt, um den maßstäblichen Ausdruck auf DIN A4 mit Standarddruckern zu gewährleisten. Ein Grundriß wird in maximal 4 Teildateien G1-G4 aufgeteilt. Im Rootverzeichnis der Lieferung befindet sich zusätzlich eine Grundrißrasterdatei GRUND.GIF mit dem ungeteilten Grundriß.

Die Datei PROT.HTM enthält die wahren Längen, Flächen und Neigungen der Dachflächen und Aufbauten des bestellten Daches. Schornsteine, Dachflächenfenster und Nachbargebäude werden dargestellt, sind jedoch grundsätzlich nicht Bestandteil der Maßliste.

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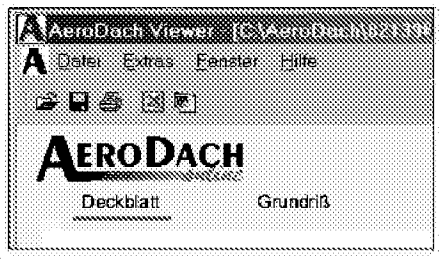
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AeroDach Viewer

Wir stellen bei Bedarf einen kostenlosen AeroDach HTML Viewer zur Verfügung.

Dieser ermöglicht als Offline Browser gegenüber den Standard-Internetbrowsern auch einen batchgesteuerten Ausdruck aller HTML-Seiten mit einem Mausklick. Dazu befindet sich im Rootverzeichnis jeder Lieferung die Datei **DRUCK.BAT**.

Außerdem ermöglicht er den Export von HTML Seiten in WORD und EXCEL.



3D-Datenformat

Das AeroDach 3D-Datenformat besteht aus einem Standardaustauschformat sowie zwei beigefügten Bilanzdateien. Dies ermöglicht sowohl den Import über eine DXF Schnittstelle als auch die vollständige Rekonstruktion der gemessenen Dachstruktur.

Für Software zur Weiterverarbeitung von Dachgeometrien wird so eine Schnittstelle bereitgestellt, die für ein entsprechendes Importmodul die konsistente Übernahme der ausgewerteten Dachflächen in die EDV ermöglicht.

Dazu werden die DXF-Daten über Layer so strukturiert, dass sich alle Flächen im Protokoll „Messergebnisse zur Dachauswertung“ identifizieren lassen. Das Protokoll wird als ergänzende Textdatei übergeben, so dass mit einfachen Mitteln ein vollständiges Knoten-Kanten-Modell der Außenhaut des Gebäudes gebildet wird.

Ein weit verbreitetes Datenformat, welches derartige Anforderungen erfüllen kann ist DXF. Es wird von nahezu jeder Graphiksoftware direkt verarbeitet, oder zumindest importiert. Weiterhin stehen zahlreiche kostenlose Viewer zur Verfügung, die jedem Anwender ohne zusätzliche Software eine 3D-Ansicht seiner Daten bietet.

Schließlich ist DXF einfach strukturiert und gut dokumentiert, so dass auch Entwickler ohne großen Aufwand entsprechende Importroutinen programmieren können.

Die AeroDach Dachaufmaße werden mit einer Versionsnummer versehen. Diese Versionsnummer wird sowohl in der Standardlieferung als auch im 3D-Datensatz einheitlich geführt Änderungen am Datenformat werden veröffentlicht



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3D Geometrie

Ein Gebäude ist in der 3D-DXF-Struktur die Summe aller ebenen Dach- und Wandflächen. Diese bilden die äußere Haut eines Körpers, der im Gegensatz zu einem 3D-Solid innen hohl ist (Flächenmodell).

Im DXF-Format werden diese Flächen als 3D-Polylines modelliert, die aus mindestens einem Hauptpolygon bestehen und zusätzlich mehrere Inselpolygone (Löcher, z.B. bei Dachausbauten) auf dem selben Layer enthalten können.

Jede zu bilanzierende Dachfläche liegt dabei auf einem separaten Layer, der sowohl identifizierend als auch klassifizierend ist. Für alle anderen Flächen (Wände, Fenster, Kamine und Lüfter) werden jeweils einheitliche Layer eingerichtet (nur klassifizierend).

Der eineindeutige Layername der Bilanzflächen stellt dagegen die 1:1-Verknüpfung mit den Sachdaten in der Flächendatei „areas.asc“ her (siehe unter Sachdaten). Auf eine redundante Speicherung der Linien- bzw. Kantengeometrie in der DXF-Datei wurde verzichtet. Die Anfangs- und Endkoordinaten der Kanten, mit denen die Verbindung zwischen Sach- und Geometriedaten hergestellt werden kann, sind direkt in der Bilanzdatei „lines.asc“ abgelegt.

Hinweis:

Die Messung aus Luftbildern bezieht sich immer auf die Außenform des Daches. Rückschlüsse auf die Unterkonstruktion bzw. Rücksetzungen darauf sind nicht Bestandteil der Messung oder Lieferung.

Dachüberstände bzw. das Zurückspringen des aufgehenden Mauerwerkes werden nicht modelliert. Dies führt bei Dachflächen von Gauben oder Aufbauten zur bilanzierungsmäßigen Vernachlässigung der von Dachüberständen überdeckten Dachflächen.

Dachflächenfenster und Schornsteine werden bei AeroDach grundsätzlich übermessen. Aufbauten und Gauben werden grundsätzlich als Löcher in der Dachfläche berücksichtigt.

Sachdaten (Bilanz) und die Verknüpfung mit der Geometrie

Die Geometriedaten sind mit den weiteren Ergebnissen der Auswertung verknüpft.

Es handelt sich hierbei um zwei ASCII-Dateien (formatfrei, mit Separator Komma), deren Inhalt und Struktur im folgenden Abschnitt kurz erläutert werden. Bis auf die Layerbezeichnungen (String) sind alle anderen Daten numerisch.

Die folgenden Layer werden derzeit berücksichtigt:

HAUPT_<name>	Hauptdachflächen
NEBEN_<name>	Flächen von Anbauten (Nebengebäude, Garagen o.ä.)
AUFBAU_<name>	Dachgauben, Aufbauten
MAUER_<name>	Brandmauern, Giebelmauern, Attika
NACHBAR	Nachbargebäudeteile (werden nicht bilanziert)
KAMIN	Schornsteine, Schächte o.ä.
FENSTER	Dachfenster
LUEFTER	Position Standardlüfter
WAND	Hauswände

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Flächenbilanz „areas.asc“

"A", 108.7668, 1867.20301399985, 1449.26043199934, 41
"a", 19.6432, 1867.58650500001, 1454.13389299903, 0
"B", 65.5595, 1876.00126399985, 1456.86904799938, 47
"C", 21.0488, 1868.31406500004, 1462.64328299928, 49
"b", 15.0629, 1859.26211999962, 1445.79138999898, 41
"c", 15.7162, 1857.40004999982, 1448.65925299935, 39
"DA", 5.9703, 1867.860812, 1466.09457999934, 5

Jede Zeile enthält die Daten einer Dachfläche:

1. Name der Fläche
2. Flächeninhalt in m²
3. Koordinate des Flächenschwerpunktes = Textposition im Grundriss (x,y)
4. Dachneigung in gerundeten Altgrad

Die Verbindung zur Geometrie ist über den Flächennamen, der Teil der Layerbezeichnung ist, realisiert.

A..Z, AA..ZZ → Hauptdach und Flächen von Nebengebäuden

a..z, aa..zz → Gauben und Aufbauten

B1.. B99 → Mauern und Dachabschlüsse (Brandmauer , Attika, ..)

Linienbilanz „lines.asc“

"1","A", " ",24.1369, 1870.9857, 1447.21847, 57.47636,"TRAUFE", 1880.88808, 1454.11714, 57.476365, 1861.083495, 1440.319800, 57.4763
"8","b", " ",6.0938, 1858.62186, 1443.853216, 0,"ORTGANG", 1859.917756, 1441.993092, 57.476365, 1857.325964, 1445.71333, 61.547851
"9","c", " ",6.3581, 1855.93018, 1447.716812, 0,"ORTGANG", 1857.325964, 1445.713330, 61.547851, 1854.534415, 1449.720296, 57.476365
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Jede Zeile enthält die Daten einer Dachflächenkante:

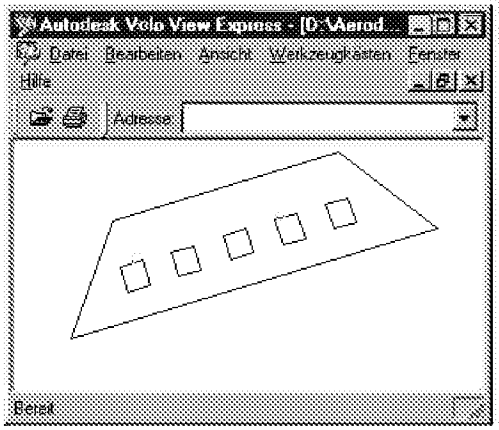
1. Name der Linie
2. Bezeichnung der 1. angrenzenden Dachfläche
3. Bezeichnung der 2. angrenzenden Dachfläche bzw. " " bei angrenzenden Wänden
4. Koordinate des Mittelpunktes = Textposition im Grundriss (x,y)
5. Höhe über dem Bezugspunkt (nur bei horizontalen Linien)
6. Funktion der Linie
7. Koordinate des Anfangspunktes (x,y,z)
8. Koordinate des Endpunktes (x,y,z)

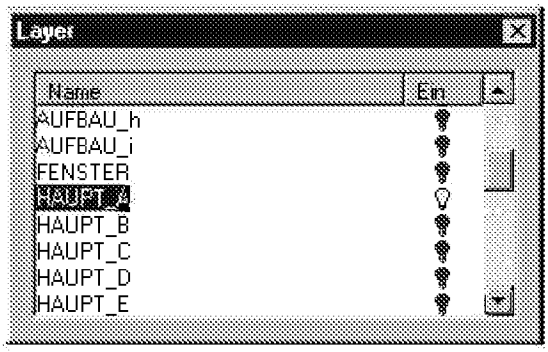
Die Verbindung zur Geometrie des Flächenmodells in der DXF-Datei erfolgt über die Koordinaten der Anfangs- und Endpunkte.

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Beispiele

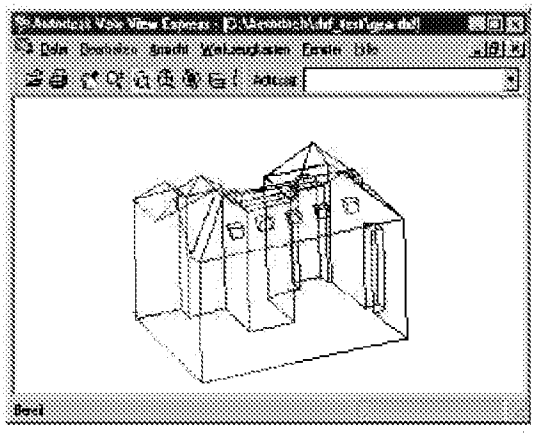
1) Dachfläche „HAUPT_A“ mit Inseln im DXF-Viewer
Jede Dachfläche liegt auf einem eigenen Layer

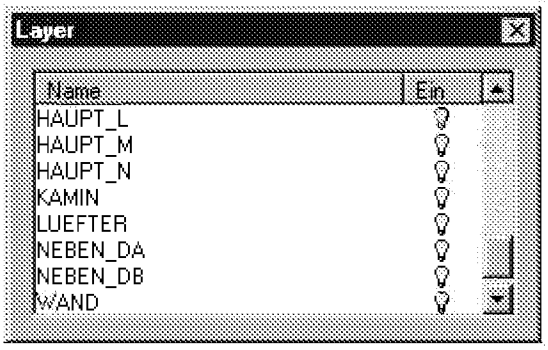




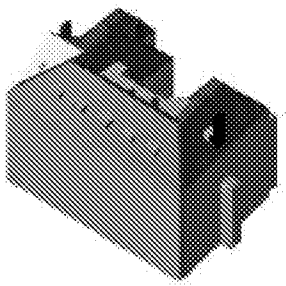
2) Gebäude mit Ausbauten und Wänden

Layernamen: <klasse>_<id>





3) Gebäude gerendert mit Farbzuordnung über Layerklasse



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Detection and Modeling of Buildings from Multiple Aerial Images

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Abstract

Automatic detection and description of cultural features, such as buildings, from aerial images is becoming increasingly important for a number of applications. This task also offers an excellent domain for studying the general problems of scene segmentation, 3-D inference and shape description under highly challenging conditions. We describe a system that detects and constructs 3-D models for rectilinear buildings with either flat or symmetric gable roofs from multiple aerial images; the multiple images, however, need not be stereo pairs (*i.e.* they may be acquired at different times). Hypotheses for rectangular roof components are generated by grouping lines in the images hierarchically, the hypotheses are verified by searching for presence of predicted walls and shadows. The hypothesis generation process combines the tasks of hierarchical grouping with matching at successive stages. Overlap and containment relations between 3-D structures are analyzed to resolve conflicts. This system has been tested on a large number of real examples with good result, some of which, and their evaluation, are included in the paper.

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1 Introduction and Overview

Automatic detection and modeling of cultural features, particularly buildings, from aerial images is becoming of increasing practical importance. Traditional applications are those of cartography and photo-interpretation. Newer applications include mission planning, urban planning, placement of communications resources and virtual tours of cities and sites. Besides the application needs, building detection and description also provides an excellent domain to explore the problems of scene segmentation, 3-D recovery and shape descriptions in a rich, realistic and demanding environment.

In this paper, we describe a system that detects and constructs 3-D wireframe models of buildings by using multiple (two or more) panchromatic aerial images. The individual and relative camera models are assumed to be known (or derived by use of some photogrammetric techniques), however, the image pairs are not necessarily stereo pairs in the usual sense- the different images may be taken at different times and may have different resolutions. We assume that the buildings are rectilinear (compositions of rectangles) in shape and that the roofs are either flat (planar *and* parallel to the ground) or are "symmetric gables" (two symmetric slanted surfaces). Walls are assumed to be vertical and the approximate ground height is assumed to be known. Illumination is assumed to be directly from the sun whose position is computable from the imaging date and time and the known geometric location of the site. Shadows are assumed to fall on flat ground of known height near the buildings. Figure 1 illustrates two views of a small part of the Ft. Hood, Texas site that will be used to illustrate our processing steps.

These assumptions constrain the task of detecting and describing the buildings. However, many of the traditional problems of computer vision must still be overcome. The objects of interest need to be segmented from the background; this is particularly difficult in aerial images due to presence of natural texture of vegetation and variety of detail present on or near the objects of interest. The 3-D structure needs to be inferred from the 2-D images; feature correspondence is made difficult due to presence of many similar features nearby (such as parallel lines near building edges) and relatively low disparity ranges for the low buildings. Even though we deal with rectilinear shapes only, specific 3-D shapes need to be recovered, conflicting descriptions need to be resolved, and in case of non-rectangular shapes, the different rectangular components need to be combined. showing The line segments detected from images in Figure 1, shown in Figure 2, should help visualize some of the difficulties outlined above (the line segments shown are from

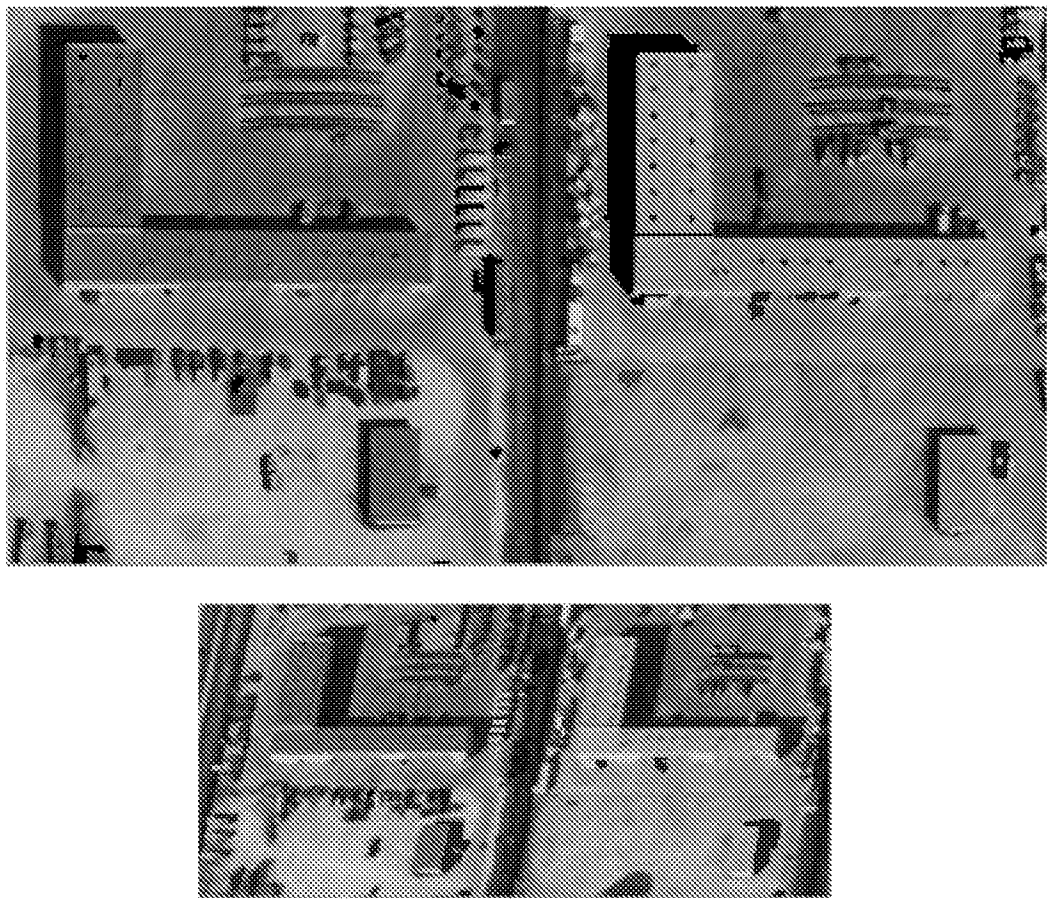


Figure 1 Two views of a portion of Fort Hood (top image is 800x425 pixels with ground sample distance, GSD, of 0.3 meters, second is 480x220 with GSD of 0.6 meters)

Canny edges [1] after linking, linear approximation, colinearization and folding of nearby parallel segments).

The problem of object detection and description, of course, has been a central one in computer vision over many years. However, the general techniques developed are not powerful enough to handle the complexities inherent in aerial images of urban scenes. There has also been intensive research in systems designed explicitly for building detection and description; [2] contains a collection of some recent efforts.

Some of the approaches have attempted to work from a single image only ([3][4][5] [6] [7] [8]). Restriction to a single image makes the problem much more difficult as feature correspondences can not be used to infer 3-D and some ambiguities are harder to resolve in a single image; consequently, they are typically restricted to the case of flat roofed buildings only. Nonetheless, such systems can provide reasonable performance on relatively simple scenes and some of the techniques developed therein are useful for multiple image analysis as well.

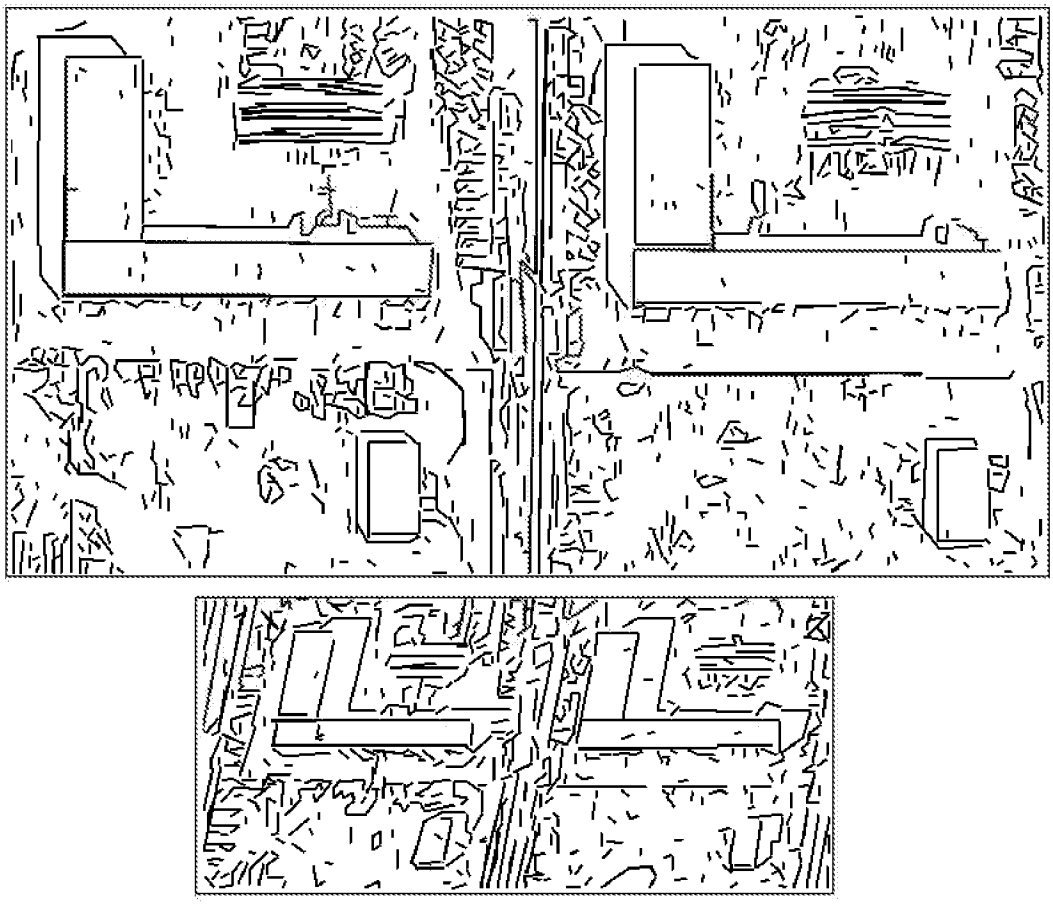


Figure 2 Linear segments extracted

Multiple images have also been used in previous work ([2][9][10][11][12][13][14]). Most of these systems assume that the images are from nadir views and taken at nearly the same time, which simplifies the task of matching features and even allows digital surface elevations to be computed by area correlation and interpolation methods. Jaynes et al. [11] describe a system that works with similar data to ours; it uses an approach to first find roof tops in a single view with the other views being used to determine the 3-D structure.

There has also been work on using data with other attributes, such as color [15], digital surface models derived from intensity images or range sensors directly ([16] [17] [18] [19] [20] [21][22]) or multi-spectral data which can significantly simplify the task of building detection and description ([23], [24]). Usually, digital surface models are derived from stereo pairs taken at nearly the same time; we assume that such models are not available for our conditions.

We provide an overview of our approach in the next section and the details in the subsequent sections. We believe that not only does our system show good results but it introduces several new features. The steps of matching and perceptual grouping are performed at each level before

proceeding to the next level. It uses a hypothesize and verify paradigm and delays decisions until more information is available to make them more reliably. The multiple views are used in an order independent way. Our approach also makes extensive use of monocular analysis even though multiple images are available. We believe that these concepts are also likely to be useful in detection and description of objects in a variety of other domains.

2 Overview

We use a *hypothesize and verify* approach to building detection and description. Hypotheses for rectangular roof components are formed by grouping image lines in each view and verification is conducted by combining evidence in all the available views and by looking for evidence of visible walls and expected shadows. The perceptual grouping process used to generate the hypotheses is a hierarchical one: line pairs are grouped to form parallels or L-junctions which are then used to form U-shapes (i.e. three sides of a rectangle) which are finally used to generate rectangular roof components. The features are matched at each level in the hierarchy. Thus, the processes of grouping and matching are carried out simultaneously. At each matching stage, we allow multiple matches to be present, thus, a feature may appear in multiple grouping hypotheses at the next level. A more conventional approach to hypothesis formation may be to first match low level features, such as lines and junctions, and use only those (now 3-D) features in grouping, but this approach requires reliable matching of low-level features which is difficult without the context of higher level groups. Our approach, however, does allow use of limited low-level feature matching to guide the hypothesis formation process and thus reduce the number of hypotheses that would be generated by a purely monocular approach as in [6]. Figure 3 shows the block diagram of the system.

This approach shares some similarities with an earlier monocular system developed in our group [6]. The perceptual grouping process is similar, however, the multiple system can be more selective due to matching of features across images. The wall and shadow verification processes are also similar but simpler because height of a hypothesis is determined prior to the application of the verification steps. The monocular system is also unable to handle buildings with slanted roofs.

3 Generation of Hypotheses

Hypotheses for building roof components are generated from the detected image features in a hierarchical fashion, matching features across views at each level in the feature hierarchy. All available views are used non-preferentially when forming hypothesis. A selection mechanism

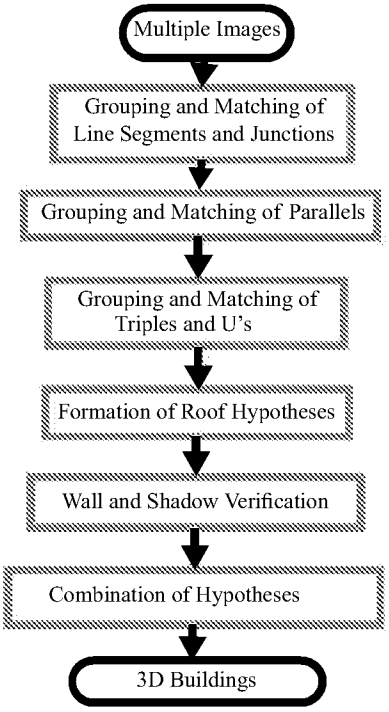


Figure 3 Block diagram of the automatic system

makes a value judgement of the evidence supporting each to eliminate those without sufficient evidence.

We first describe the feature hierarchy and the constraints applied at each stage in grouping and matching of the features. We then describes the method for hypothesizing and selecting flat-roof and gabled roof hypotheses in this order.

3.1 Grouping and Matching of Features

The feature hierarchy in order of complexity consists of lines, junctions, parallels and U-contours. These feature sets are then used to hypothesize flat and gable roofs.

Lines:

The lines are formed by linking of edgels and colinearization of line segments. Lines are matched by using the following ***epipolar constraint.*** The match for a line segment in one view must lie at least partially within a quadrilateral defined by the epipolar geometry and the 3D height constraints. Consider Figure 4. Let line l in $view_1$ have endpoints p_1 and p_2. By the epipolar constraint for points, the match for p_1 in $view_2$ must lie on an epipolar line defined by p_1, say l_1'. Similarly a match for p_2 must lie on l_2'. A particular height in the world coordinate system corresponds to a particular point on the epipolar line. Hence, knowing the local ground height in the world coordinate system, and the maximum height of a building in 3-D, the search space can be reduced to the segment on each epipolar line defined by these z-coordinate values. In general,

there are 4 distinct points, two for each epipolar line. This limits the search for matching segments to a quadrilateral defined by these four points. In Figure 4 these points are denoted by p_{11}', p_{12}', p_{21}' and p_{22}', corresponding to line l. Each pair of lines (l, l') that satisfy the epipolar (quadrilateral) constraint in any pair of views is determined to form a line match and included in the set of line matches that we will call S_{lm}, and is passed to the higher levels for further processing.

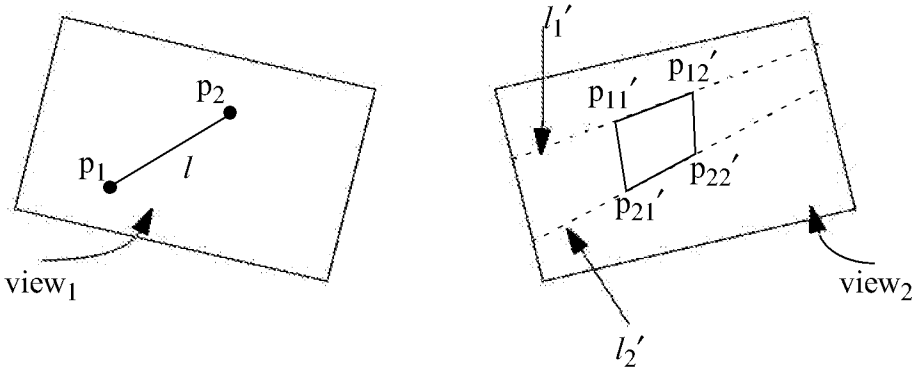


Figure 4 Quadrilateral (epipolar) constraint

Note that a line in one view may match multiple lines in other views, causing multiple matches (e.g. nearby vertical lines in Figure 2). We do not attempt to further disambiguate the matches at this level.

Junctions

Junctions are formed by intersections of nearby line segments. Let the set of junctions formed in $view_i$ be denoted by S_{Ji}. Junctions in the sets S_{Ji} ($i = 1..n_{views}$) are then matched across the views, when the following constraints are satisfied:

- **Epipolar constraint:** The matching junctions in two views must be on corresponding epipolar lines and within a certain range (depending on the allowed height range in 3D).
- **Line Match Constraint:** The lines that form the two matching junctions must themselves match (*i.e.* the line pairs must be present in the line match set S_{lm}).
- **Orthogonality Constraint:** Given a junction match, we can compute the 3D angle between the lines forming it (from the knowledge of the matching lines). This angle is required to be nearly orthogonal (between 80^o and 100^o) in 3D as we are looking for rectilinear structures only.
- **Trinocular Constraint:** When there are more than 2 views available, the well-known trinocular constraint may be applied to the locations of the junctions. Functionally, given a point p_1, in $view_1$, and a point, p_2 on the epipolar line of p_1 in $view_2$, a point p_3 in $view_3$. is determined uniquely (the intersection of the epipolar lines of p_1 and p_2 in $view_3$).

Note that a junction in one view may match multiple junctions in other views, causing multiple junction matches for the same junction. Let Sj_m be the set of junction matches.

Parallels

Starting with the lines in S_{lm}, parallel pairs of lines are detected in each the view and are matched across views. Parallels are formed between pairs of lines, L_{ij} and L_{ik} in the same $view_i$, when the following constraints are satisfied:

- Lines L_{ij} and L_{ik} are nearly parallel (make an acute angle of less than 10^o; ideally this angle should be a function of the line lengths and expected errors in point positions).
- The perpendicular distance between L_{ij} and L_{ik} is less than the maximum projected width of a building.
- At least 50% of L_{ij} overlaps with L_{ik} OR at least 50% of L_{ik} overlaps with L_{ij}.

The pair of lines (L_{ij}, L_{ik}) forms a parallel. Along with the lines L_{ij} and L_{ik}, an abstract representation in the form of two line segments is stored. Denote these line segments by L_{ij}' and L_{ik}'. The angle of L_{ij}' and L_{ik}' is the average of the angles of L_{ij} and L_{ik} weighted by the lengths of L_{ij} and L_{ik}. If necessary, L_{ij} and L_{ik} are extended to form L_{ij}' and L_{ik}' so that they overlap completely (and are of same length in the image). Figure 5 illustrates the extension process. The representation (L_{ij}', L_{ik}') is used in the computation of parallel matches.

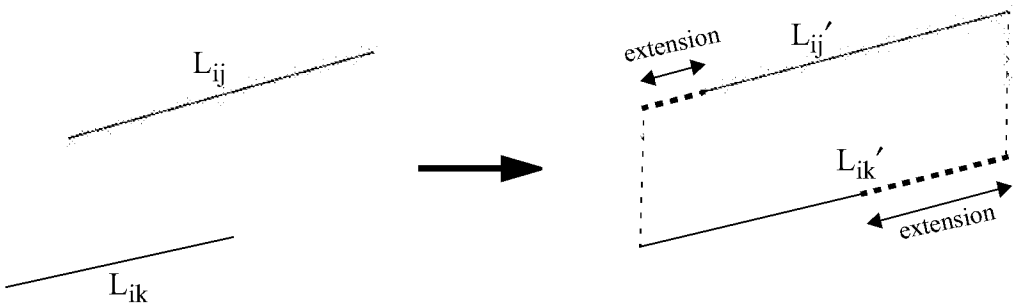


Figure 5 Extension of lines forming a parallel

While the task domain causes a large number of parallels in each view (two to three times the number of lines in that view), because of the alignment of buildings, roads, parking lots and shadows, the number of parallel matches is typically lower than the number of lines in any view. A parallel match is hypothesized if there is evidence in at least two views. When there are matching parallels in more than two views, a single parallel match (called a maximal parallel match) is formed across all the views. The constraint used in matching is the parallel match constraint described below:

- **Parallel match constraint:** Consider parallels P_{ik} with component segments L_{ik1} and L_{ik2} in $view_i$, and P_{jl} with component segments L_{jl1} and L_{jl2} in $view_j$. The parallel match constraint is satisfied for this pair of parallels if and only if exactly one of the following criteria is met:
  - (L_{ik1}, L_{jl1}) and (L_{ik2}, L_{jl2}) are elements of S_{lm}

- (L_{ik2}, L_{jl1}) and (L_{ik1}, L_{jl2}) are elements of S_{lm}

Parallel matches may be formed across two or more views. If there are a total of n views, parallel matches over the views are represented as n-tuples. The set of parallel matches is denoted by S_{pm}. Matches across more views dominate the matches across fewer views. Thus, if there are 4 views and (P_{11}, P_{21}, nil, nil) and (P_{11}, nil, P_{31}, nil) are detected as parallel matches, they are replaced by the maximal parallel match (P_{11}, P_{21}, P_{31}, nil) in S_{pm}. Note that a parallel in one view may match multiple parallels in other views, causing multiple parallel matches for the same parallel.

U-contours

U-contours correspond to three sides of a rectangle. Suppose a parallel in $view_i$ is denoted by lines (l_{i1}, l_{i3}). If there exists a junction j in S_{ji} such that j may be denoted as either (l_{i1}, l_{i2}) or (l_{i3}, l_{i2}), then (l_{i1}, l_{i2}, l_{i3}) is a potential U-contour, say U. U is a valid U-contour iff a major part of l_{i2} lies between l_{i1} and l_{i3}.

3.2 Formation of flat-roof rectangular hypotheses

The flat-roof hypotheses are formed by using the feature sets computed above. Two methods are used: one that uses information from multiple images directly and another that uses information from a single image only.

3.2.1 Generation of hypotheses from multiple images

Let S_{pmj} denote a parallel match in the set of parallel matches S_{pm}. Denote the constituent parallels of S_{pmj} by P_{ij} where j is the image number. For each P_{ij}, a search is launched, in view i, to determine the best closure of the parallel match as follows:

- Starting from the center of the parallels in the parallel match, search for possible closure lines towards each end . A closure line is one that lies between the lines forming the parallel, and which forms an acute angle of less than 10^o with the projection of the line orthogonal to the parallel in 3D and parallel to the ground plane in 3D.
- The search is also extended beyond ends of the parallel for lines that are elements of the set of matched lines, S_{lm}, and are thus guaranteed to have matches in at least one other view. We have found a search that extends to 25% of the length of the parallels to be effective.
- Detect possible closures, by scoring the coverage of the gap between the parallel lines. All closures covering greater that half the gap between the parallel lines are considered. The score of the closure is the ratio of the sum of lengths of the lines forming the closure to the distance between the ends of the parallels. Note that the search is performed simultaneously on all the images and hence the closures are matched as they are detected.
- Put qualifying closures into two sets: one foreach half of the parallel match.

- Generate all combinations of closures from the two sets to generate 3-D hypotheses.

3.2.2 Generation of hypotheses from each image independently

Not all desired hypotheses are typically generated by the above method as some of the features are present (or detected) in only one view. To compensate for this, additional hypotheses are generated by using evidence that is partly visible in a single view only. 2-D parallelograms generated in each view from each U-contour (which come from the matched lines). For each 2-D parallelogram hypothesis a search determines if there is sufficient evidence for it in the other views. This search is performed iteratively through the space determined by epipolar geometry and by the 3-D height constraints on a hypothesis. When an acceptable match is found a 3-D hypothesis is created. The following describes the process in detail.

- For $view_i$ let the set of U-contours be S_{ui}. Computation of U-contours is described in Section 3.1.
- For each U-contour U (say (l_1, l_2, l_3)), in S_{ui}, search for line evidence to support the side that could complete a parallelogram. The direction of the search is the same as the orientation of the l_1 (or l_3). The search starts at a distance of 1/4th of the length l_1 (or l_3) from the ends of l_1 (or l_3) and proceeds the same distance beyond the l_1 (or l_3). Line segments that are approximately parallel to l_2 i.e. which form an acute angle less than 10^o with l_2, and which lie in the search space, are collected.
- Group clusters of these line segments into colinear lines if possible. Each of these clustered groups of lines causes a 2-D parallelogram hypothesis to be formed. Denote a representative hypothesis by p_u.
- For each 2-D parallelogram hypothesis search the other views for matching information. The aim of this search is to determine the best 3-D hypothesis by considering the hypothesis as a whole. The method varies the height parameter from the ground height to the maximum height of a building in small increments (1/10th of the range) and scores the line evidence for the hypothesis in all the views at each height. Each local maxima of the scores forms a 3-D hypotheses.

Figure 6 shows (in one view only) the combined hypotheses generated by the two methods from the lines shown in Figure 2. Note that multiple hypotheses are formed for several roof components as well as several other hypotheses are formed that correspond to no building. Next, a selection procedure is applied to filter out some of these hypotheses.

3.3 Selection of flat-roof rectangular hypotheses

It is possible to apply the verification procedure that uses all available evidence to choose among the generated hypotheses. However, this is a relatively expensive process. Instead, the set is first reduced in size by applying a simpler selection process that uses roof evidence only. The nature

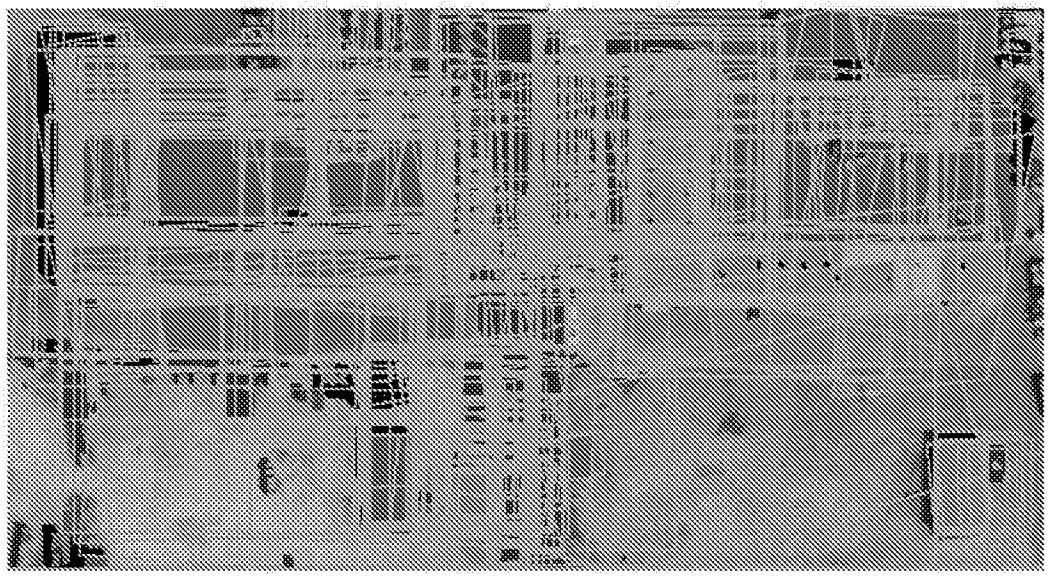


Figure 6 Hypotheses detected in images from Figure 1 (only one view is shown).

of the evidence used is discussed in Section 3.3.1 and method for using this evidence in Section 3.3.2.

3.3.1 Accumulating Selection Evidence

- Positive roof evidence:

Positive roof evidence consists of line segments in each view that support a hypothesis. As the hypothesis are 3-D models and camera parameters are known, the models can be projected in each available view. Consider an arbitrary view, say view_i. Let the projected parallelogram of the 3-D hypothesis be $(p_{i1}, p_{i2}, p_{i3}, p_{i4})$. A spatially-indexed search is used to detect line segments, such that each line segment l_i satisfies the following criteria:

- l_i must form a small acute angle (of less than 10^o) with one of the four sides of the parallelogram
- the perpendicular distance of the midpoint of l_i from any one of the sides of the parallelogram is small (less than 4 pixels).
- a major part (> 50%) of l_i overlaps with the side of the parallelogram it is closest to

The contribution of a line l in the set of positive evidence lines to the positive score is the ratio of the length that l overlaps with the nearest side of the roof hypothesis (in the image) to the perimeter. This automatically weights longer sides (and evidence supporting them) more than it does shorter sides.

- Negative roof evidence

Consider an arbitrary view, $view_i$. Let the projected parallelogram of the 3-D hypothesis be (p_{i1}, p_{i2}, p_{i3}, p_{i4}). A spatially-indexed search is used to detect line segments, such that each line segment l_i satisfies the following criteria:

- l_i must intersect at least one of the four sides of the parallelogram
- l_i must form a large acute angle (of greater than 30^o) with a side of the parallelogram that it intersects
- a major part (> 50%) of l_i overlaps with a side of the parallelogram it intersects

The contribution of a line l in the set of negative evidence lines to the negative score is the ratio of the length of l to the perimeter (in the image). This operation is performed on all the views available, and the evidence i.e. the line segments, is grouped by view for later evaluation. Figure 7 illustrates the concepts of positive and negative line evidence in one view for flat-roof hypothesis.

- Height inference

A new 3-D height is computed for each roof hypothesis based on optimal matching in all available views. Assume that the parallelogram corresponding to the projection of a 3-D hypothesis in $view_i$ is represented by a set of 4 lines $\{l_{ik}\}$ with k=1..4. The lines in the set $\{l_{ik}\}$ are matched to lines $\{l_{jl}\}$ in $view_j$ subject to the quadrilateral constraint described in Section 3.1. As the height of the 3-D line that projects into l_{ik} is varied between the minimum and maximum heights, the projection of this line in $view_j$, l_{ik}', traverses the quadrilateral defined in the quadrilateral constraint. Parameterize this traversal with parameter s=0 corresponding to the minimum height (possibly the ground plane) and s=1 corresponding to the maximum height.

As parameter s is varied from 0 through 1, l_{ik}' will match different lines, $\{l_{jl}\}$, in the quadrilateral. This gives rise to multiple matches at different parameters (and hence different 3-D heights). Define a proximity measure for line l_{ik}, d_{ijkl} as the perpendicular distance from the midpoint of l_{ik} to any line l_{jl} in $\{l_{jl}\}$. Define a measure of the goodness of the match for a set of lines $\{l_{ik}\}$ in $view_i$, m_s, at parameter value s, over all n_{views} views by

$$m_s = \sum_{j \neq i} \sum_{k,l} e^{-\left(\sigma^2 \cdot d_{ijkl}^2\right)} \cdot len(l_{jl})$$

where σ is chosen to be 0.5 (hence $\sigma^2 = 0.25$) and $len(l_{jl})$ is the length of l_{jl}. The physical significance of this is to weigh the lines in $\{l_{jl}\}$ by the distance from the projection of l_{ik} in $view_j$ (l_{ik}') and have that weight drop off exponentially. This may be done with an arbitrary set of lines $\{l_{ik}\}$ over any number of views from 1 to n_{views}. The value of s at the maximum of the function m_s is used as the best match of the set of lines $\{l_{ik}\}$. This value of s corresponds to the 3-D height at which the line support across views is the maximum.

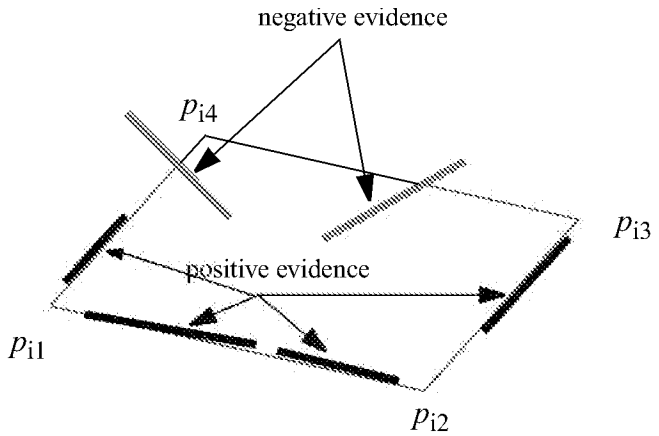


Figure 7 Positive and negative line evidence

3.3.2 The selection mechanism

Hypotheses that are not within an acceptable height range (typically between 2m and 20m above ground) are eliminated. Even though, some height constraints have been applied in earlier stages of hypothesis generation, the refined height estimate allow application of a more stringent criterion. Remaining hypotheses are examined for roof evidence.

Two roof quality measures are computed. One is the average positive line score, *avg_pos_score*, computed from the positive scores for each view (normalized to be between 0 and 1). The second is the average of the difference between positive and negative line scores, called *avg_diff_score*. A hypothesis is selected if and only if $posRoofScore\ /n_{views} > 0.5$ and $(posRoofScore - negRoofScore)/n_{views} > 0.3$.

Figure 8 shows the selected hypothesis from Figure 6. Note that the number of hypothesis is greatly reduced. Most of the undesired hypotheses have been eliminated without rejecting the desired ones (though this may not always be the case).

3.4 Formation of gable-roof rectangular hypotheses

Figure 9 shows two views of an aerial scene containing symmetric gable-roof buildings. To generate hypotheses for such roofs, a *triple* of parallel lines is computed first (the triples are to correspond to the "ridge" or the top of the roof and the two sides).

Triples

Triples are derived from the set of parallels constructed earlier. All lines are considred, regardless of whether they also participate in flat roof hypotheses (overlaps are resolved as described in Section 5). Suppose that a parallel P_{ik} in $view_i$ comprises line segments L_{ik1} and L_{ik2}. A search is launched for line segments L_{ik3} that lie either between L_{ik1} and L_{ik2}, or on the side of

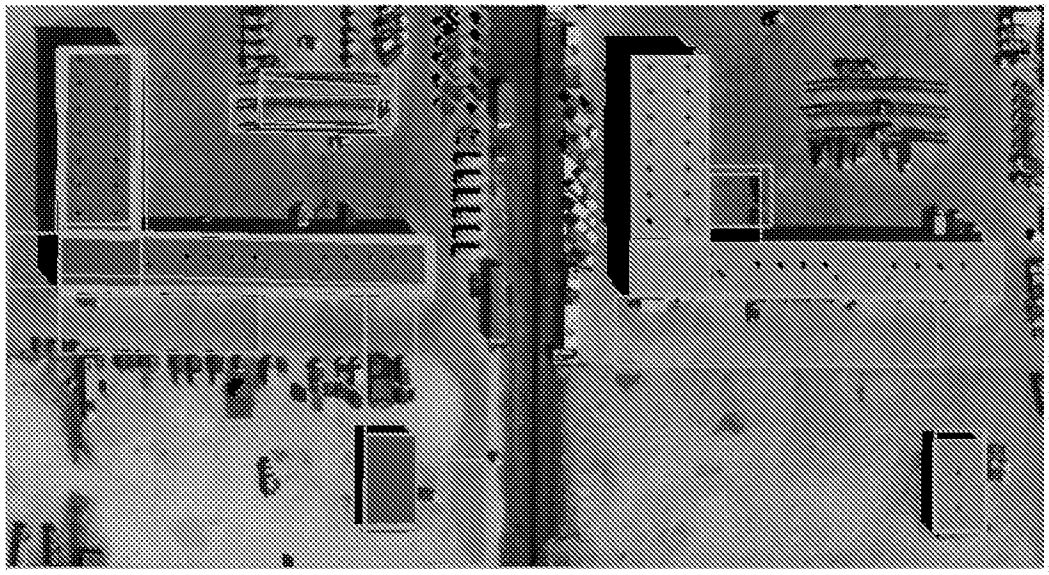


Figure 8 Selected hypotheses from the images in Figure 1

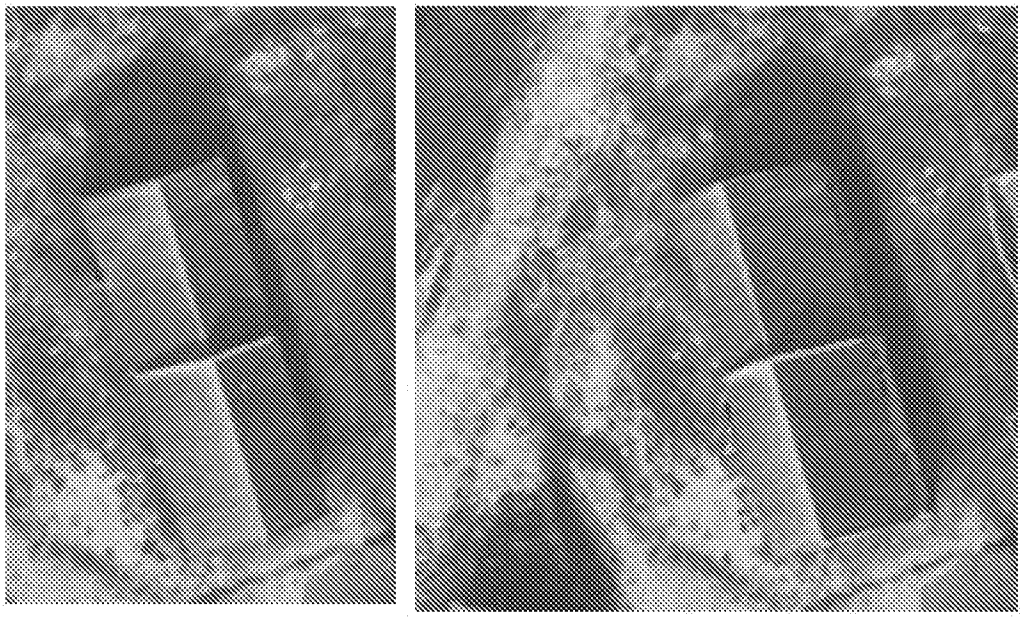


Figure 9 Two views of an aerial scene with symmetric gable-roof buildings. Left image is 155x240 pixels, right image is 240x240 pixels, both have GSD of 0.15 meters

L_{ik1}, or on the side of L_{ik2}. L_{ik3} must have an orientation similar to L_{ik1} and L_{ik2} i.e. the acute angle between L_{ik3} and L_{ik1} (or L_{ik2}) is less than 10^{o}l.

3.4.1 Generation of symmetric gable-roof hypotheses

The generation of a gable-roof hypothesis is initiated by a triple in any image. Triples are examined to see if they could give rise to valid 3-D hypotheses as follows: Given a camera model, and ground height, the relative height in 3-D of the "ridge" of the gable roof with respect to the sides in that view may be derived as follows. Assuming that the gable is symmetrical in 3-D, if the ridge and the sides were at the same height, they would project to equidistant parallel lines in the

image (as the projection is orthographic locally). However, as the ridge is higher than the sides, it must be displaced in the direction of the projection of the vertical (in 3-D) in that image. The extent of displacement from the center, in the image, provides an estimate of the relative height of the ridge with respect to the sides. This constraint is extremely important in filtering out triples that could not give rise to a valid gable hypothesis, as it does not rely on matching information from other views.

For each triple in the set of triples a search is conducted for matching sets of lines in the other views. The height of the ridge is varied through the maximum and minimum allowed heights of a building. At each iteration (height) the search scores the goodness of the supporting line features for a hypothesis over all the views. Maxima of these scores are used to hypothesize gable-roof hypotheses at the heights at which the maxima occur. At this point the system possesses 3-D information for the ridge and the sides, but no information about the extent of the hypothesis *i.e.* we need to determine closures for the hypothesis.

Closures for gable-roof hypotheses are determined by search for terminating junctions on the lines forming the ridge and the sides of the roof in all the views. The system uses binary junctions. If a junction j is to be a terminator, the lines that form j, say l_1 and l_2, must meet the following constraints in order to qualify as a terminator for the hypothesis:

- either l_1 or l_2 should be a component of exactly one of the lines forming the triple
- if l_1 is a component of one of the lines in the triple, l_2 is constrained to be the projection of a 3-D line, say L_2, that is perpendicular in 3-D to the 3-D ridge and the 3-D side closest to L_2. The system has computed the 3-D orientations of the sides and the ridge. The location of the 3-D junction J, corresponding to its projection j, must lie on the 3-D ridge or on one of the sides of the gable in 3-D. The terminator of the gable is uniquely defined by these constraints. This terminator must correspond to L_2, and its projection to l_2. If the acute angle between the projected terminator and l_2 is less than 10^o, l_2 is a valid terminator.

In general, more than one termination may be found on each end of the roof. The junctions with the highest scores at each end that are valid terminators are selected as the terminators for this hypothesis. If no terminators are found, or if terminators for only one side are found the hypothesis is rejected. Figure 10 shows the results of gable-roof formation on the images in Figure 9. Note that this process is much more selective than is the case for flat roofs as many more constraints apply to the gable roof case.

3.5 Selection of gable-roof hypotheses

The gable roof hypotheses selection procedure is very similar to that for flat roof hypotheses; however, the selection can be more liberal as the number of false hypotheses generated is much

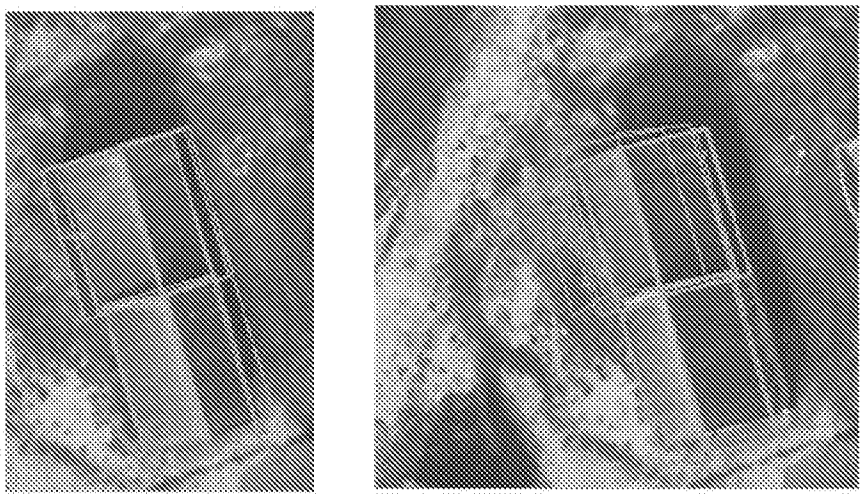


Figure 10 Gable-roof hypotheses for the images in Figure 9

smaller. Positive and negative evidence for roof is computed as before by using image lines that overlap the projected roof lines and negative evidence by the intersecting lines. This evidence is encapsulated into a "roof score", which allows the hypotheses to be thresholded. The roof score is computed using the positive and negative roof evidence including the positive and negative contributions to the ridge of the gable-roof.

A hypothesis is selected if *posRoofScore* /n_{views}> 0.4 and *(posRoofScore - negRoofScore)*/ n_{views} > 0.25. Selected gable-roof hypotheses for the images in Figure 9 are shown in Figure 11.

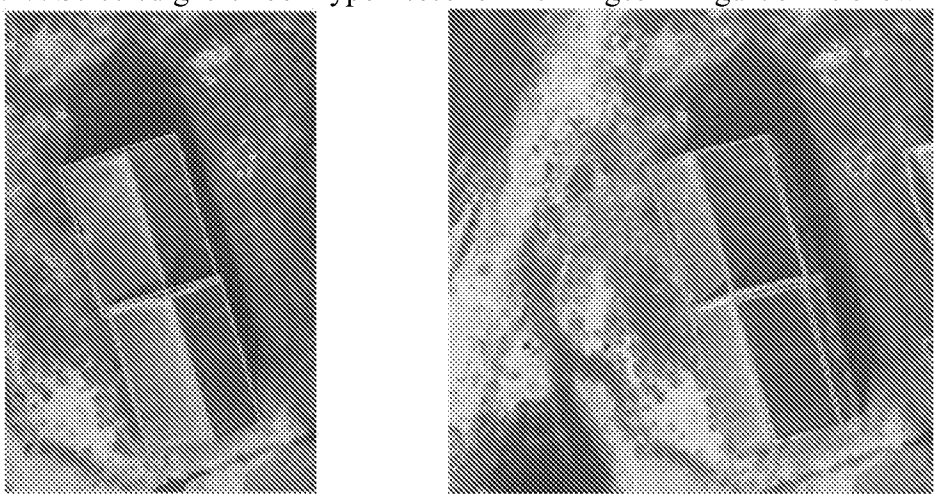


Figure 11 Selected gable-roof hypotheses for the images in Figure 9

4 Verification of Building Hypotheses

The selection mechanism, covered in Section 3, demonstrates that the use of roof evidence and the predicted 3-D height provide good filters for removing hypotheses that do not satisfy the geometric constraints necessary for being declared a building. Additional evidence, consisting of cues for presence of visible walls and shadows cast by a hypothesized building are used to make

further discriminations. Statistical properties of the regions of the hypothesized roof and the shadows cast are also used.

In Section 4.1 the verification process for flat-roof building hypotheses is described. Section 4.2 outlines the verification process for gable-roof hypotheses. At this stage mutually exclusive overlapping or contained hypotheses (both flat-roof and gable-roof) may exist. Section 5 outlines the overlap disambiguation process.

4.1 Verification of the flat-roof hypotheses

In the verification process, the system uses the available geometric, photometric and domain-specific constraints such as expected shadow and wall lines, to determine whether a selected hypothesis is a building or not as described below.

4.1.1 Collecting the verification Evidence

Roof Evidence

Roof evidence for a hypothesis for verification is the same as used in the selection stage dewscribed in section 3.3.1 earlier.

Wall Evidence

In each view which is not nadir at least one and not more than two of the side walls of the buildings should be visible. The walls are assumed to be vertical in 3-D. The verification for walls involves looking for the projections of the horizontal bottom of the wall (the interface of the vertical wall and the ground). Wall evidence is deemed to be found if there is evidence of parallel lines at the distance from the top of the building that is predictable from its height in 3D. A score is computed based on how much of the predicted wall line is covered by an image line. Wall evidence is summed over the multiple available views.

Shadow Evidence

A 3-D building structure should cast shadows under suitable imaging conditions. The system has knowledge of the direction of illumination from the sun, which allows it to predict the location and orientation of shadows (on flat ground) from the 3-D hypotheses. Shadows have previously been used in monocular detection of buildings [6]. In this system, the analysis is made easier as an estimate of the height of the building is available. Even though the 3-D height of the building is known, a search for shadows is conducted within a small window (5 pixel wide) about the predicted shadow to account for various inaccuracies in estimations of the height, the sun position and the camera models. Figure 12 shows the search for shadows. We assume that the shadow falls on a flat ground of known height and that at least part of it is not occluded by other buildings.

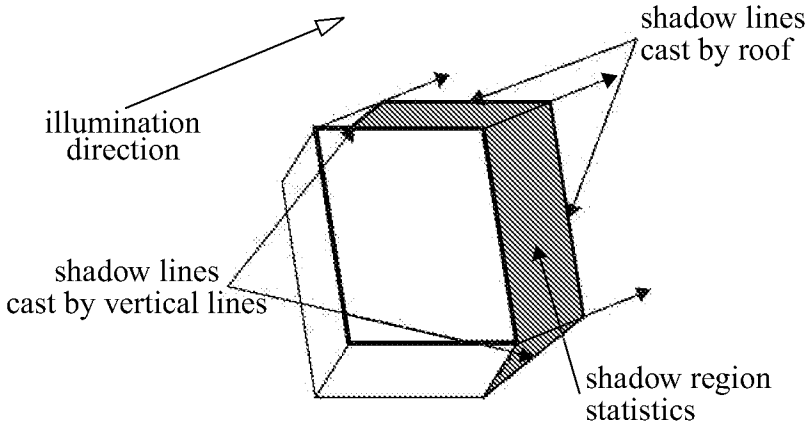


Figure 12 Search for shadow evidence

The evidence searched for includes the shadows cast by the horizontal roof lines, and the shadows cast by the vertical walls of the building. The evidence is in the form of detected lines at or near the outline of the predicted shadow. A shadow score is computed from the shadow evidence. This score is the fraction of the visible shadow outline that has supporting line evidence. Occlusion of shadows by the building itself is taken into consideration when searching for shadows. Score for multiple views is added to obtain a total score.

4.1.2 Use of Roof, Wall and Shadow Evidence in Verification

The roof, wall and shadow evidence are collectively used to verify a selected flat-roof hypothesis. The verification process uses a decision tree involving the evidence available. Suppose that a 3-D hypothesis has a roof score of r (as computed in Section 3.3.1), a shadow score equal to s and a wall score that equals w. If there are n_{views} views being considered then

- if $r \geq 0.75 * n_{views}$ the hypothesis is verified and the verification process exits. Experimental evidence indicates that not more than 30% of the (eventually verified) buildings satisfy this criterion.
- if $r < 0.75 * n_{views}$, shadow evidence is considered.
  - if $s \geq 0.25 * n_{views}$, or if the shadow evidence $s_i \geq 0.5$ in some $view_i$ the hypothesis is verified and the verification process exits.
  - if $s < 0.25 * n_{views}$ and $s_i < 0.5$ for all i=1..n_{views} and $r \geq 0.5 * n_{views}$ and if $w \geq 0.5 * n_{views}$, then the hypothesis is verified and the verification process exits.
  - if $s < 0.25 * n_{views}$ and $s_i < 0.5$ for all i=1..n_{views} and $r < 0.5 * n_{views}$ the hypothesis is not verified and the verification process exits.
- if none of the conditions enumerated above are satisfied the hypothesis is not verified and the verification process exits.

The results of verification of hypotheses generated from the pair of images in Figure 8, using the above rules, are shown in Figure 13.

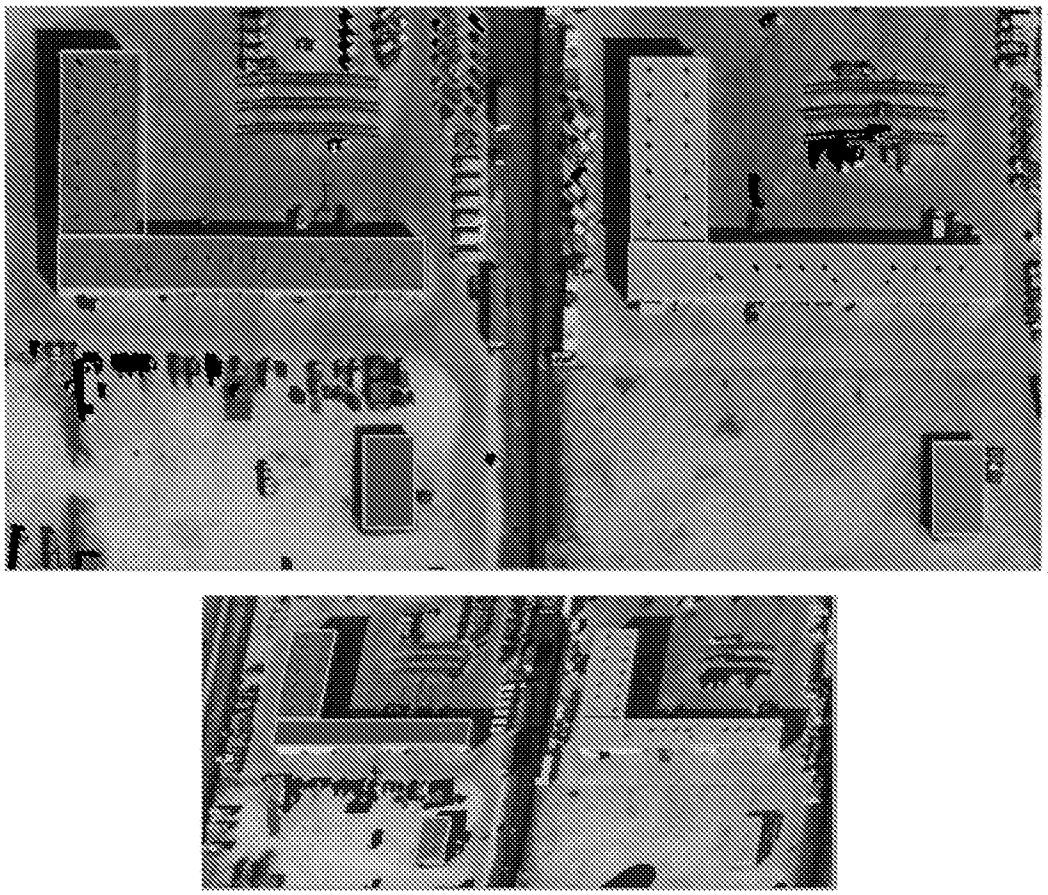


Figure 13 Verified hypotheses for the images in Figure 1

The roof, shadow and wall scores are combined using a sum of weighted averages to yield a confidence measure. If r is the roof score, s is the shadow score, and w is the wall score of a building hypothesis, the equation used to obtain a verification score (or confidence measure), v, for a verified hypothesis is $v = (r_{wt} * r) + (s_{wt} * s) + (w_{wt} * w)$, where $r_{wt} = 0.6$, $s_{wt} = 0.3$ and $w_{wt} = 0.1$. Also $r_{wt} + s_{wt} + w_{wt} = 1$. The reason for weighting wall evidence lower than roof and shadow evidence is that it is usually less reliable than roof evidence and shadow evidence. This confidence measure is used in overlap disambiguation that is covered in Section 5.

4.2 Verification of the gable-roof hypotheses

The verification process for gable roof buildings is similar to that of flat roof buildings but the evidence used is more complex because of the complexity of the roof shapes. Collection and use of such evidence is described next.

4.2.1 Collecting the verification Evidence

Roof Evidence

Roof evidence for a hypothesis from the selection process for gable-roof hypotheses, described in Section 4.1.2, is used in the verification process as well.

Wall Evidence

The wall evidence for a gable-roof hypothesis is similar to that of an equivalent flat-roof hypothesis because the only difference in the generic model used for the flat-roof hypothesis and that used for the gable-roof hypothesis is the shape of the roof. As the wall evidence is independent of the shape of the roof, it is collected by treating a gable-roof hypothesis as a flat-roof hypothesis (by ignoring the "ridge").

Shadow Evidence

The search for shadows for gable-roof hypotheses differs from the search for shadows for flat-roof hypotheses. The shape of the gable-roof, coupled with the differing height of the "ridge" of the gable, as compared to the sides of the gable, cause shadow lines that are not parallel to the sides of the building causing them. However, knowing the heights of the sides and the "ridge" of the gable in 3-D, and the direction of illumination, the system predicts the shape before launching a search for supporting line evidence. This search includes the shadow cast by the roof, and the shadow cast by the vertical walls of the building. Following is an algorithmic description of the search for shadows of gable-roof hypotheses:

- Figure 14 shows a typical shadow cast by a gable-roof hypothesis (in view i). Suppose the 3-D extremities of the gable-roof G are denoted by P_1 through P_6. Denote the projection of P_1 though P_6 in $view_i$ by p_{1i} through p_{6i} (refer to Figure 14).
- The extremities of the visible shadow are computed using the sun angles to be ps_{1i} through ps_{4i}.
- Search for line evidence that supports the outline of the shadow in a window of 5 pixels on either side of the predicted shadow outline.
- The shadow score, s, is computed using the same method as that used for flat-roofs in Section .

4.2.2 Use of Roof, Wall and Shadow Evidence in gable roof verification

The method for determining whether a selected gable-roof hypothesis should be verified or not is very similar to that for flat-roof hypotheses described earlier. Suppose that a 3-D gable-roof hypothesis has a roof score of r (as computed in Section 4.1.2), a shadow score equal to s and a wall score that equals w. If there are n_{views} views being considered then

- if $r \geq 0.5 * n_{views}$ the hypothesis is verified and the verification process exits.

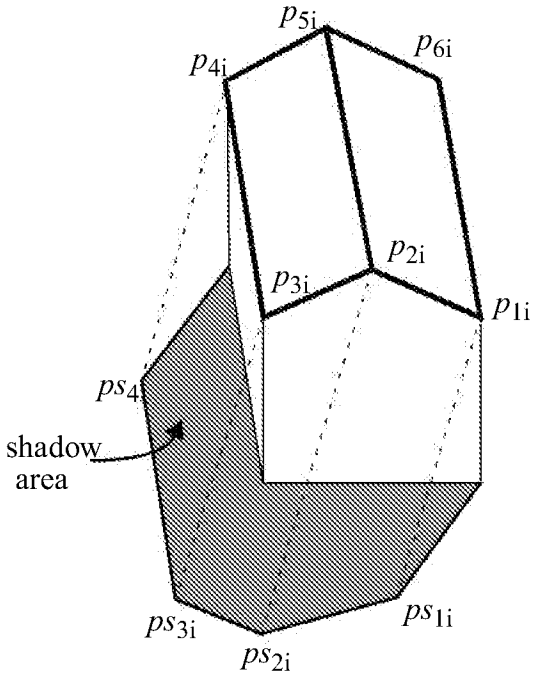


Figure 14 Shadow cast by a gable-roof hypothesis

- if $r < 0.5 * n_{views}$, shadow evidence is considered.
  - if $s \geq 0.1 * n_{views}$, or if the shadow evidence $s_i \geq 0.2$ in some $view_i$ the hypothesis is verified and the verification process exits.
  - if $s < 0.1 * n_{views}$ and $s_i < 0.2$ for all $i=1..n_{views}$ and $r \geq 0.25 * n_{views}$ and if $w \geq 0.1 * n_{views}$, then the hypothesis is verified and the verification process exits.
  - if $s < 0.1 * n_{views}$ and $s_i < 0.2$ for all $i=1..n_{views}$ and $r < 0.25 * n_{views}$ the hypothesis is not verified and the verification process exits.
- if none of the conditions enumerated above are satisfied the hypothesis is not verified and the verification process exits

When compared to the algorithm for flat-roof hypotheses, the thresholds used for gable-roof hypotheses are low. The reason for this is that a gable-roof hypothesis needs a greater number of lines to form its roof and its shadows, thus raising the possibility that some of these components will either not be found, or be found with less feature support, and hence lower confidence. This is compensated for by the fact that there are a greater number of applicable constraints to gable-roof hypothesis in the hypothesis formation stage, than there are to flat-roof hypothesis, and hence fewer gable-roof hypotheses than flat-roof hypotheses are usually formed for identical numbers of basic features (lines). The results of verification on the selected gable-roof hypotheses shown in Figure 10 are depicted in Figure 15.

The roof, shadow and wall scores are combined using a sum of weighted averages to yield a confidence measure. If r is the roof score, s is the shadow score, and w is the wall score of a building hypothesis, the equation used to obtain a verification score (or confidence measure), v, for a verified hypothesis is: $v = (r_{wt} * r) + (s_{wt} * s) + (w_{wt} * w)$ where $r_{wt} = 0.85$, $s_{wt} = 0.05$ and $w_{wt} = 0.05$. Also $r_{wt} + s_{wt} + w_{wt} = 1$. The reason for weighting wall evidence and shadow evidence lower than roof evidence is that their expected shapes are complex, and usually less reliable than roof evidence. This confidence measure is used in overlap disambiguation that is covered in Section 5.

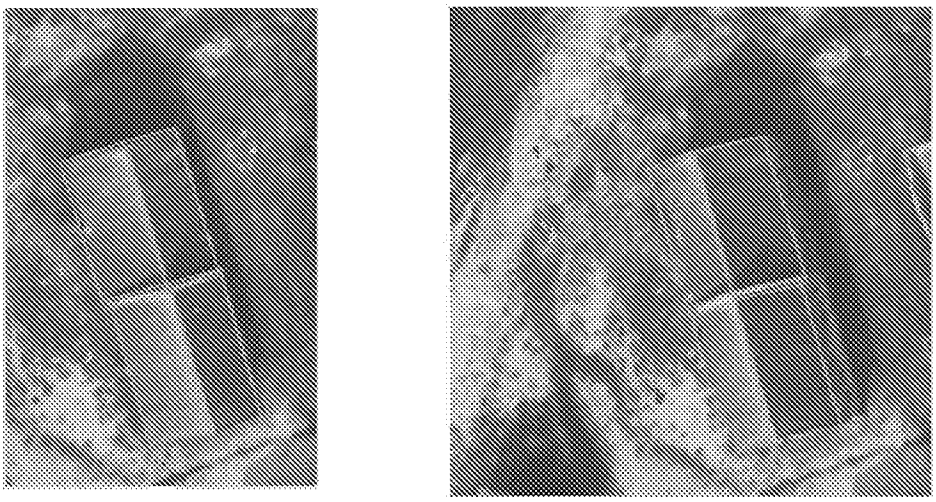


Figure 15 Verified gable-roof hypotheses for the images in Figure 9

5 Overlap analysis

The system verifies selected flat-roof and gable-roof hypotheses one at a time. Hence it is possible that verified hypotheses may overlap in 3-D. Selection among overlapping hypothesis is conducted for all verified rectangular components by dropping the models to the ground plane, and testing whether their projections overlap on the ground plane. This effectively reduces overlap testing to a 2-D problem. Note that more than two hypotheses may overlap. In these cases hypotheses are handled in pairs, recursively, till there are no conflicts. The use of verification scores as a discriminator ensures that the process is order-independent, as it orders a set of overlapping hypotheses in an unambiguous way. There are three distinct cases where overlap occurs (the first two cases are similar to those described in [6]).

5.1 Complete overlap or containment

If verified hypothesis H_2 is completely contained in verified hypothesis H_1 (in 3-D), and the difference in 3-D heights of H_1 and H_2 is small (say less than 1m), then H_2 is removed from the set of verified 3-D hypotheses. If the difference in height is larger, then both H_1 and H_2 are included in the verified hypotheses. This case implies than H_2 is a superstructure of H_1.

5.2 Partial overlap with no shared evidence

When two hypotheses partially overlap but neither is completely contained by the other, and they share no common roof evidence, then the one with the higher verified score is retained.

5.3 Partial overlap with shared evidence

When hypotheses H_1 and H_2 partially overlap and neither is completely contained by the other, but they share common roof evidence, a differential process determines which of H_1 and H_2 survives. The rationale for using a differential process in this case is that the hypotheses will have very similar scores, as they share evidence, and that the differences must be highlighted in order to make a finer judgement about which hypothesis is better.

Suppose in $view_i$, hypothesis H_1 is projected to h_1 and H_2 is projected to h_2. Computation of the differential evidence is done thus:

- without loss of generality say side l_{11} of h_1 shares evidence with side l_{21} of h_2.
- search for line segments for the section of l_{11} that do not overlap with l_{21}, and for l_{21} that does not overlap with l_{11}.
- score this roof evidence as the fraction of the searched segment that is covered by actual line evidence, using the method for scoring roof evidence described in Section 3.3.2.
- repeat the process for all sides of h_1 and h_2 that share evidence in $view_i$
- repeat the steps described above on all views.
- compute the line evidence for the part of the predicted wall lines of $h1$ that is not shared with $h2$, and for the part of the predicted wall lines of $h2$ that is not shared by $h1$ (differential wall evidence)
- compute the line evidence for the part of the predicted shadow lines of $h1$ that is not shared with $h2$, and for the part of the predicted shadow lines of $h2$ that is not shared by $h1$ (differential shadow evidence)

The differential score for H_1 is the verification score computed using Equation in Section 4.1.2 if H_1 is a flat-roof hypothesis or using Equation in Section 4.2.2 if H_1 is a gable-roof hypothesis, using the differential roof, shadow and wall scores as input. The differential score for H_2 is computed by the same method. The hypothesis with a higher differential score survives, while the one with a lower differential score is eliminated from the set of verified hypotheses. It is interesting to note that the architecture of the system allows different models (like flat-roof and gable-roof buildings) to be disambiguated using the same methodology.

The verified buildings, both flat-roofed and gable-roofed, are 3-D structures. The 3-D information of the verified buildings coupled with the camera model and the terrain model of the scene can be used to generate the 3-D wire frame model of the scene. At this point, texture-mapping

may be applied to reconstruct the scene from viewpoints other than those captured in the views. This ability to generate realistic views from arbitrary viewpoints has interesting applications such as fly-by simulations.

6 Results and Evaluation

This section shows results on some examples. We have used sections of the Fort Hood, Texas and Fort Benning, Georgia sites. These datasets have been commonly available and allow for comparisons among different systems. We first show graphical results in Section 6.1 and then present an evaluation in Section 6.2.

6.1 Results

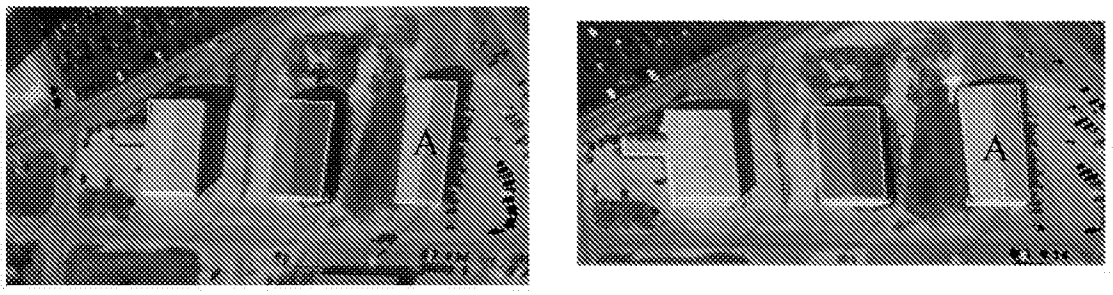
6.1.1 Results on Fort Hood, Texas

Fort Hood, Texas is a site with several hundered 100 buildings. The site is characterized by low buildings of varying shape, size, orientation and roof intensity. It has foliage and trees that clutter the background, as well as a number of man-made structures such as car park areas, vehicles and vehicle ports that create accidental alignment of features that sometimes qualify as buildings. The views are acquired from nadir as well as oblique angles, and at resolutions varying from 0.3 m/pixel to 1.3 m/pixel. They are acquired at different times of the day (at different days in the year) leading to widely varying image characteristics in the different views for the same area on the ground. Only selected examples are shown here due to lack of space.

Figure 16 shows results on some gable roof buildings, however, the roof slope is quite low and hence the buildings are described as flat-roof buildings. One half of the building labeled A is included in the set of verified hypotheses. The whole building (detected as a flat-roof) exists in the set of selected hypotheses. However, that hypothesis is eliminated by the one labeled A, as this hypothesis has much stronger roof evidence, and the differential evidence in favor of the other hypothesis is not sufficient to raise its confidence beyond that of the hypothesis labeled A. Note that the shadow evidence is common, and the wall evidence is almost negligible.

Figure 17 shows a set of multi-level buildings. The roofs in this example, are of varying intensities within each view. In addition, the intensities vary significantly across views, for corresponding areas in each view. Examining the building labeled B in both images shows that the system is able to detect buildings even if they have small protrusions, if a sufficiently large segment of the roof exists to be enable it to be pieced together using perceptual grouping.

Figure 18 shows two views of complex buildings in a relatively uncluttered background. The part of the building labeled C is an example of a building that exists but is not detected (a true



Verified hypotheses

Figure 16 Gable-roof buildings detected as flat-roof buildings. Left image is 456x250 with GSD of 0.5m, right image is 450x215, GSD 0.4m



Figure 17 Example of multi-level buildings. Top view is 775x500 pixels, GSD of 0.3m, bottom view is 465x280 with GSD of 0.6m.

negative). The building exists in the set of all hypothesized buildings, but is not selected. The reason it is not selected is that the other part of the building, labeled D, occludes different sections of C because it is taller and the viewpoint causes occlusion, and also because it casts a shadow on

C. This causes a mismatch along an entire side of C, and its consequent elimination in the selection process.

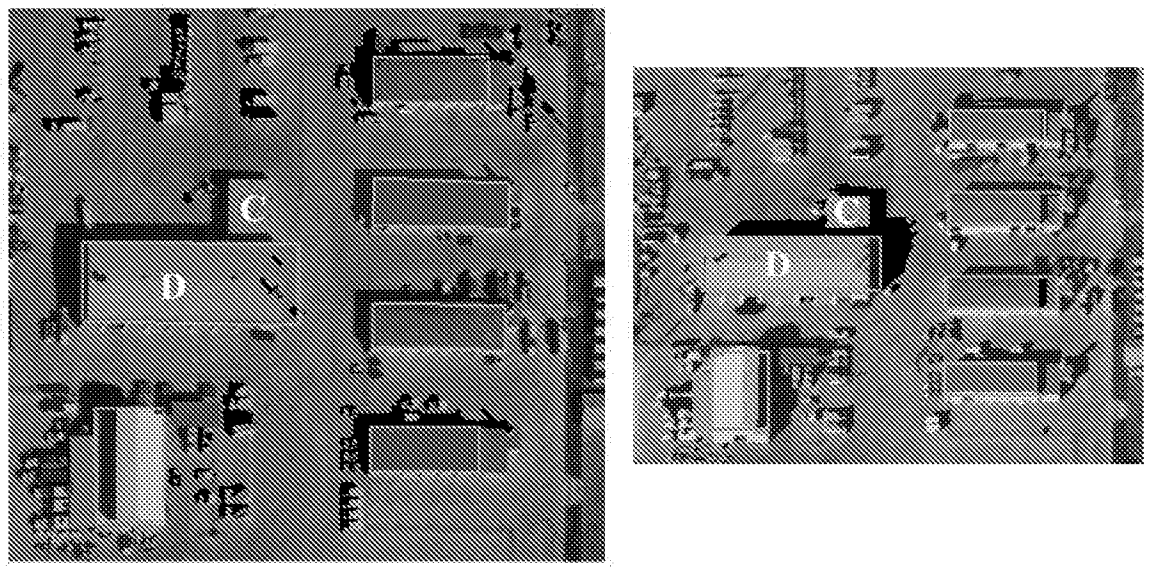


Figure 18 Complex buildings in a relatively uncluttered background. Left view is 500x460 pixels, GSD of 0.33m, right view is 325x260 pixels, GSD of 0.5 m

Figure 19 shows a model constructed by the automatic system for large parts of the Fort Hood site (results shown are on a nadir view but two oblique views are also used for processing). These results were obtained by breaking the nadir image into consecutive sections for efficiency; each section contained several buildings as in examples shown earlier. The sections were selected simple to limit the size of the images to be processed. Only a pair of views was used for each section, however, different pairs of views may have been used in each example as no single pair overlapped completely in the area shown in each of the examples.

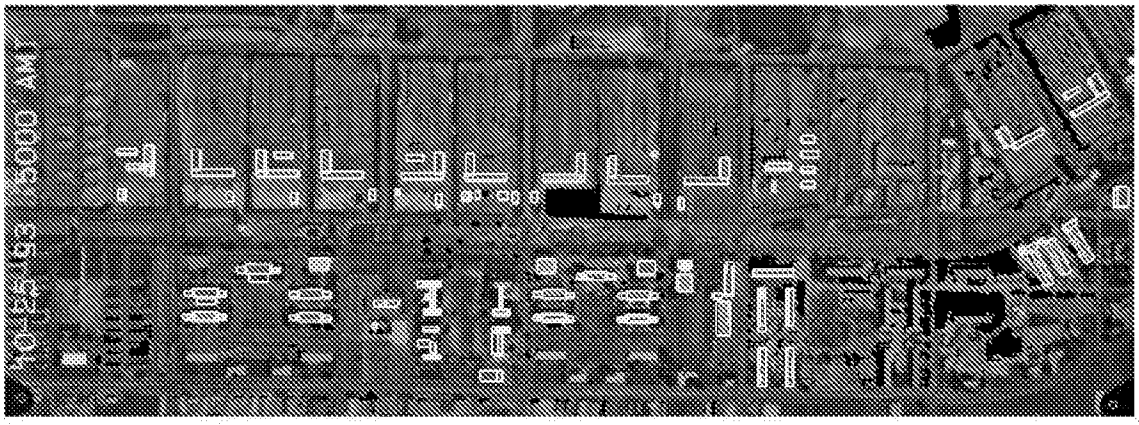


Figure 19 Model constructed from several sub-images using three views, displayed on a nadir image. This image is 7600x2700 pixels with GSD of 0.3 m, the oblique views have a smaller GSD (similar to other images of the same site shown elsewhere).

6.1.2 Results for Fort Benning, Georgia

The Fort Benning dataset differs from the Ft. Hood dataset in that buildings have varying shape, size, orientation and roof intensity. The buildings have very distinct markings on the roofs that complicate the task of delineating them and there are a number of gable-roof buildings. The site has as a small number of prominent roads that create distinct features in the images. Both view are nadir. Figure 20 shows the combined hypotheses on buildings in this site (the overlap between flat and gabled roof hypotheses is not resolved).

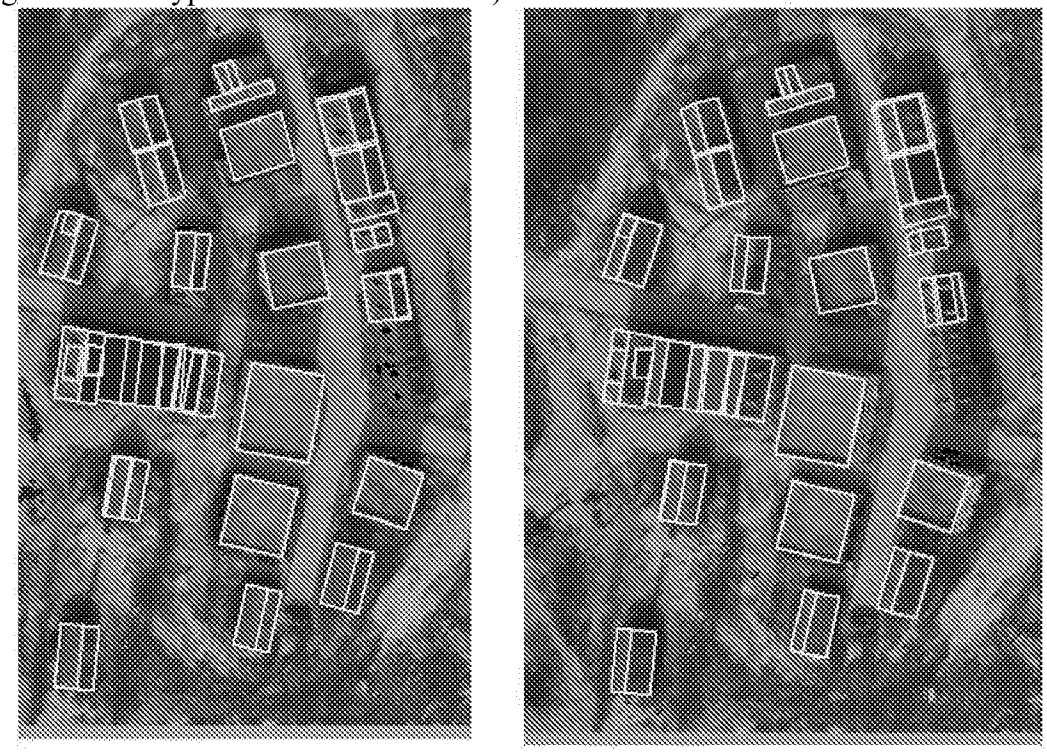


Figure 20 Combined hypotheses (flat-roof and gable-roof buildings). Left image is 345x540 pixels, right image is 400x540 pixels. GSD for both is 0.28 m.

6.2 Evaluation of the automatic system

We describe the run times, the detection accuracy and effect of multiple views followed by a discussion of the effects of system parameters in this section.

6.2.1 Run-time Evaluation

The run-times for the system depend on the complexity of the images and the number of features in them. For the example shown in Figure 1 , the total run time was approximately 225 seconds. Edge and line detection take 55 seconds. Hypothesis formation, selection and verification required 70, 65 and 35 seconds respectively. The runtimes grow approximately linearly with the size of the image for scenes cf similar complexity.

6.2.2 Detection Evaluation

The following measures proposed in [6] are computed by making a comparison of the automated results with a reference model constructed manually:

T_p (True Positive) is a building in the reference model and detected by the program

F_p (False Positive) is a building detected by the program but not present in the reference model

T_n (True Negative) is a building in the reference model but not detected by the program.

These are combined to give the following two numbers:

- Detection Percentage = $100 \times T_p / (T_p + T_n)$

Branch Factor = $100 \times F_p / (T_p + F_p)$

In the above computations, a building is considered to be detected, if a part of the building is detected by the system. The description of the detected building may not necessarily be correct. To compute acccuracy of the delineation, three other measures consisting of the correct building pixel, incorrect building pixel and correct non-building pixel percentages, are calculated by labeling every pixel in the image as either a building pixel or a non-building pixel as proposed by Shufelt and McKeown in [7]. We did not evaluate height accuracies explicitly though displays on multiple images show that the heights for correctly detected buildings are highly accurate. More sophisticated approaches to delineation accuracy are described in [25].

A large section of the Motor Pool area of the Fort Hood site is selected for evaluation using the parameters described above. The area was run in sections with between 3 and 14 buildings in each section. Each section was run using two overlapping views. Figure 19 shows the model depicted in 3 different views. The buildings vary considerably in size, shape and image characteristics. Many rectilinear buildings are composed of rectangular parts. In order to characterize the performance of the system, the parameters T_p, T_n and F_p are computed for complete (possibly multi-part) buildings, as well as for individual rectangular building fragments. The derived measures, namely the detection percentage and the branch factor, are computed independently in each case. The results are summarized in Table 6.1. The pixel-based measures show 97.1% correct building pixels, 4.3% incorrect building pixels and 99.8% correct non-builiding pixels. It may be noted that the pixel-based measures indicate better performance than the

measures for individual buildings or building fragments because the large buildings are detected, with false positives and true negatives being usually small.

Table 6.1

	T_p	T_n	F_p	Detection Percentage	Branch Factor
Complete (rectilinear) buildings	84	4	14	95.45%	14.2%
Rectangular building fragments	134	11	14	92.41%	9.46%

6.2.3 Effect of Multiple Views

The system presented here handles two or more views non-preferentially. Comparison of results using three views and using two views demonstrates that the additional view sometimes aids the building detection and description process with respect to detecting buildings (or parts of buildings) that were not detected using two views (*i.e.* T_p is increased, T_n is decreased). More importantly, the additional view causes the number of false positives (F_p) to decrease. Table 6.2 shows T_p, T_n and F_p using three views, for the sections of Fort Hood that have at least three overlapping views. Comparison of Table 6.2 with Table 6.1 shows that the third view increases detection percentage and reduces the branch factor. 97.4% correct building pixels, 3.9% incorrect building pixels and 99.8% correct non-building pixel measures are found. Tests run with four views do not increase T_p, or decrease T_n in the areas of Fort Hood that have at least four overlapping views. In these results, the areas with three views are a subset of the areas with only two views. However, the scene is quite homogeneous and the performance does not vary greatly in different parts and hence we believe that the given comparison is meaningful, particularly due to the large reduction in the false positives. In general, the value added by a view will depend on several factors such as its viewing angle, the direction of illumination and occlusions from the viewpoint. We were not able to conduct such evaluations due to the difficulty of acquiring sufficiently varied datasets.

6.2.4 Choice of Parameters

Our system needs to make several decisions based on incomplete evidence at various stages in the selection and verification processes. Evidence from several components, such as lines is combined to compute a single score. Evidence in various categories such as from roofs, walls and shadows is combined to make decisions on keeping or discarding hypotheses. Due to the

Table 6.2

	T_p	T_n	F_p	Detection Percentage	Branch Factor
Complete (rectilinear) buildings	27	1	0	96.43%	0.00%
Rectangular building fragments	38	3	0	92.68%	0.00%

complexity of the processes involved, and lack of formal models for the contents of an image, it is difficult to find theoretically optimal solutions. Our procedures for such decision making are based on simplicity and intuitive judgements (such as weighting the evidence for various lines in proportion to their length). There is also a new effort in our group to use Bayesian models learned from examples for improved decision making [26].

Our system has been tested on a large number of examples with most of the parameters being either fixed or automatically adjusted based on available input information such as the image resolution with the user supplying the minimum and maximum dimensions of the acceptable buildings only. Some internal parameters could have been chosen from photogrammetric information such as errors in the bundle adjustment process but this was not done in the described experiments.

7 Conclusions

We have presented a system for detecting rectilinear buildings with flat or symmetric gable roofs from multiple intensity images. We believe that our results are encouraging and are similar to or better than results shown from other contemporary systems. It is now common for many systems to use hypothesize and verify approach to object detection and modeling. However, we believe that our approach of interleaving feature grouping and matching and delaying decisions until more information is available for a better decision is novel. Our system also treats all images in a non-preferential, order independent way.

We believe that the approach presented here can be easily generalized for more complex, but specific shapes (such as for regular polygon shaped roofs) but would require major modifications to handle more general cases. The system is also limited in its ability to handle buildings which are rectilinear but highly complex such as consisting of many wings, or cases where the buildings are

very close to each other (such as in the "downtown" district of a major city). Modeling of more complex buildings in more complex surrounds remains a topic for future research.

Acknowledgments

The authors thank Andres Huertas for his help in the preparation of this paper and for providing systems software support during the conduct of the research.

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Roof Wizard

Especially suited to metal roofing.



Sample Reports

1. Quotation Form
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7. Order Form
8. Tax Invoice
9. Roof Drawing
10. Flashing Drawing
11. Block Layout

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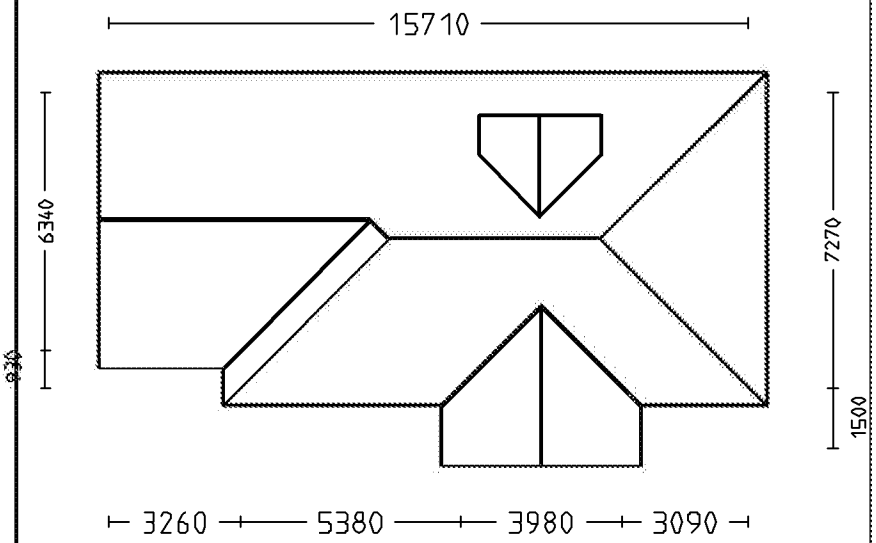
123 Church St
Hawthorn
03 9819 3100
03 9819 3200
Note 2
ACN: Note 1

YOUR COMPANY LOGO

Date 17 September 2002

Job No

Customer	**Address**	**Site address**
Phone		
Mobile		
Fax		**Builder name**
		Phone



ALL FORMS ARE BASED ON USER DEFINED TEMPLATES - TO SUIT YOUR NEEDS.

Roof Pitch	25.0
Height	2700
Rafter CTS	600
Eaves	450
Gable Finish	

For the supply and installation of

Roof
Corrugated 0.42, Galvanised
Ridge
BHP Ridge capping, Merino
Fascia
Metal fascia, Stone
Gutter
O Gee Gutter, Smooth Cream
Valley
Not included
Barge
Rake flashing, Smooth Cream
Batten
Not included
Insulation
Not included
Downpipes
Not included
Curved Roof
Not included

TOTAL **1193.56**

PLEASE READ THESE TERMS AND CONDITIONS

This estimate is based on the roof described by the plan and specifications set out above and it is the customers responsibility to ensure, when accepting the estimate that the plans and specifications set out above conform with the customers requirements as any variation from such plan and/or specifications shall entitle us to vary the price on the basis of such variation.

This estimate will lapse on the expration of thirty (30) days from the above date.

Special Notes

Sorcerer File : MetalTut.DAB Model : mod1

Applicad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200
ACN: Note 1
Note 2

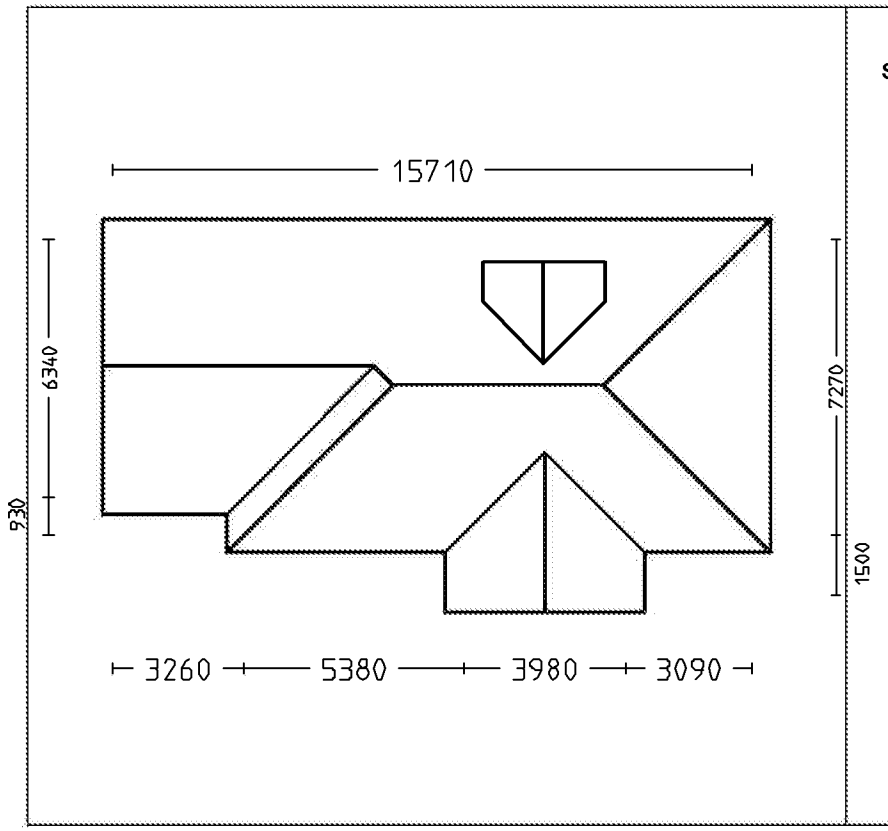
YOUR COMPANY LOGO

17 September 2002

Dear sir,

We have pleasure in submitting our quotation for the carrying out of the following works at

ALL ROOF DETAILS ARE AUTOMATICALLY PRINTED OUT WITH YOUR COMPANY LOGO AT THE TOP



Special Notes

Total quoted price : **1193.56**

No allowance for fall protection guards if applicable

Assuring you of our best service at all times !!

This quotation is valid for a period of sixty (60) days from the date hereof. Our terms of trade are net cash 30 days from our completion of our contract with you.

Yours faithfully,

Applicad Roofing

Applicad Roofing

123 Church St
Hawthorn
03 9819 3100
03 9819 3200
Note 2
ACN: Note 1

Date 17 September 2002

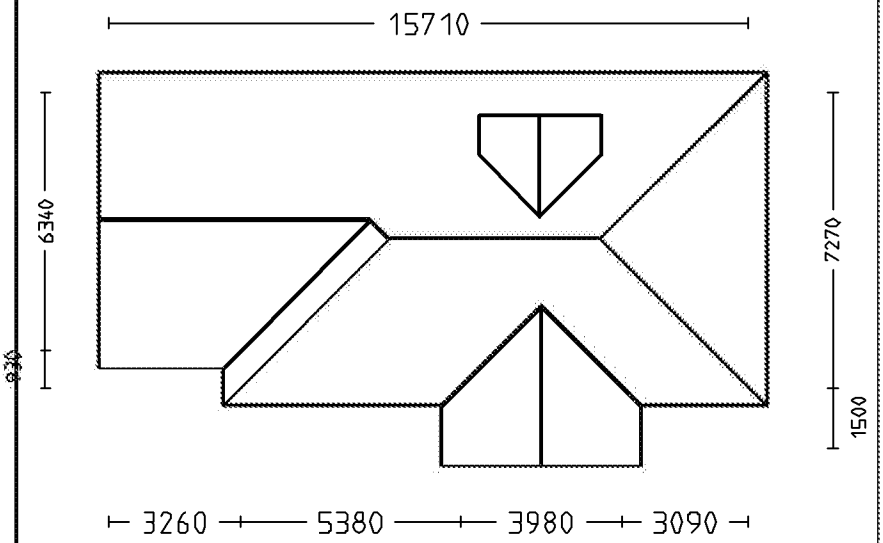
Job No

Customer **Address**

Phone
Mobile
Fax

Site address

Builder name
Phone



Roof Pitch	25.0
Height	2700
Rafter CTS	600
Eaves	450
Gable Finish	

For the supply and installation of

Roof
Corrugated 0.42, Galvanised
Ridge
BHP Ridge capping, Merino
Fascia
Metal fascia, Stone
Gutter
O Gee Gutter, Smooth Cream
Valley
Not included
Barge
Rake flashing, Smooth Cream
Batten
Not included
Insulation
Not included
Downpipes
Not included
Curved Roof
Not included

TOTAL **1193.56**

PLEASE READ THESE TERMS AND CONDITIONS

This estimate is based on the roof described by the plan and specifications set out above and it is the customers responsibility to ensure, when accepting the estimate that the plans and specifications set out above conform with the customers requirements as any variation from such plan and/or specifications shall entitle us to vary the price on the basis of such variation.

This estimate will lapse on the expiration of thirty (30) days from the above date.

Special Notes

A CLEAR & CONCISE QUOTATION OF WHAT IS BEING INSTALLED. INCLUDING AN ACCEPTANCE OF THE JOB FOR THE CUSTOMER TO SIGN OFF ON.

ACCEPTANCE : I wish to advise of acceptance of your quote and of terms and conditions

Name **Signature** **Date**

Sorcerer File : MetalTut.DAB Model : mod1

17 September 2002

Applicad Roofing

Quotation Details

ACN: Note 1
123 Church St
Hawthorn
03 9819 3100
03 9819 3200

A DISCOUNT CAN BE APPLIED FOR EACH ITEM THAT IS TO BE INSTALLED ON THE ROOF

Job number
Order number
Delivery date 17 September 2002

Category	Item description	Qty	Rate	Subtotal	Disc	Total
Cartage	Cartage	0.00	0.12	0.00	0	0.00
Straight roofing	BHP, BHP-2,Corrugated 0.42, Galvanised	169.06	2.00	338.11	0	338.11
Ridge	BHP, BHPRC1,BHP Ridge capping, Merino	37.22	2.00	74.44	0	74.44
Fascia	BHP, FBHT42CTL–,Metal fascia, Stone	58.67	1.00	58.67	0	58.67
Gutter	BHP, OG60–,O Gee Gutter, Smooth Cream	41.95	1.00	41.95	0	41.95
Barge	BHP, CBVCTL–,Rake flashing, Smooth Cream	16.72	2.00	33.44	0	33.44
Accessories	BHP, FB-1,Fascia bracket,Stone	47.00	1.00	47.00	0	47.00
	BHP, SC-1,Snap clip,Stone	47.00	1.00	47.00	0	47.00
	BHP, EB-1,External bracket,Smooth Cream	47.00	1.00	47.00	0	47.00
	BHP, EXCNR-90,External corner 90,Smooth Cream	3.00	1.00	3.00	0	3.00
	BHP, INTCNR-90,Internal Corner 90,Smooth Cream	3.00	1.00	3.00	0	3.00
	BHP, SE-L,Stop end left,Smooth Cream	4.00	1.00	4.00	0	4.00
	BHP, SE-R,Stop end right,Smooth Cream	8.00	1.00	8.00	0	8.00
Fasteners	BHP, BHFP1265HT17,12x65,Hex Head type 17,Galvanised	1015.00	0.01	10.15	0	10.15
	BHP, BHFP1265HT17,12x65,Hex Head type 17,Merino	19.00	0.01	0.19	0	0.19
	BHP, BHFP1265HT17,12x65,Hex Head type 17,Stone	30.00	0.01	0.30	0	0.30
	BHP, BHFP1265HT17,12x65,Hex Head type 17,Smooth Cream	38.00	0.01	0.38	0	0.38

Material sub total	716.63	
Material mark up	10.00	
Material total		788.30
Labour sub total	264.96	
Labour mark up	12.00	
Labour total		296.76
Job total		1085.06

THIS REPORT IS AUTOMATICALLY GENERATED
All accessories (e.g. fascia brackets, snap-clips etc) are automatically included in the quotation. The price for each accessory item including any fasteners to secure the accessory to the roof is automatically costed and accounted for.
NOTHING IS FORGOTTEN FROM THE QUOTE

17 September 2002

Applicad Roofing

Roofing Pay Summary

ACN: Note 1
123 Church St
Hawthorn
03 9819 3100
03 9819 3200

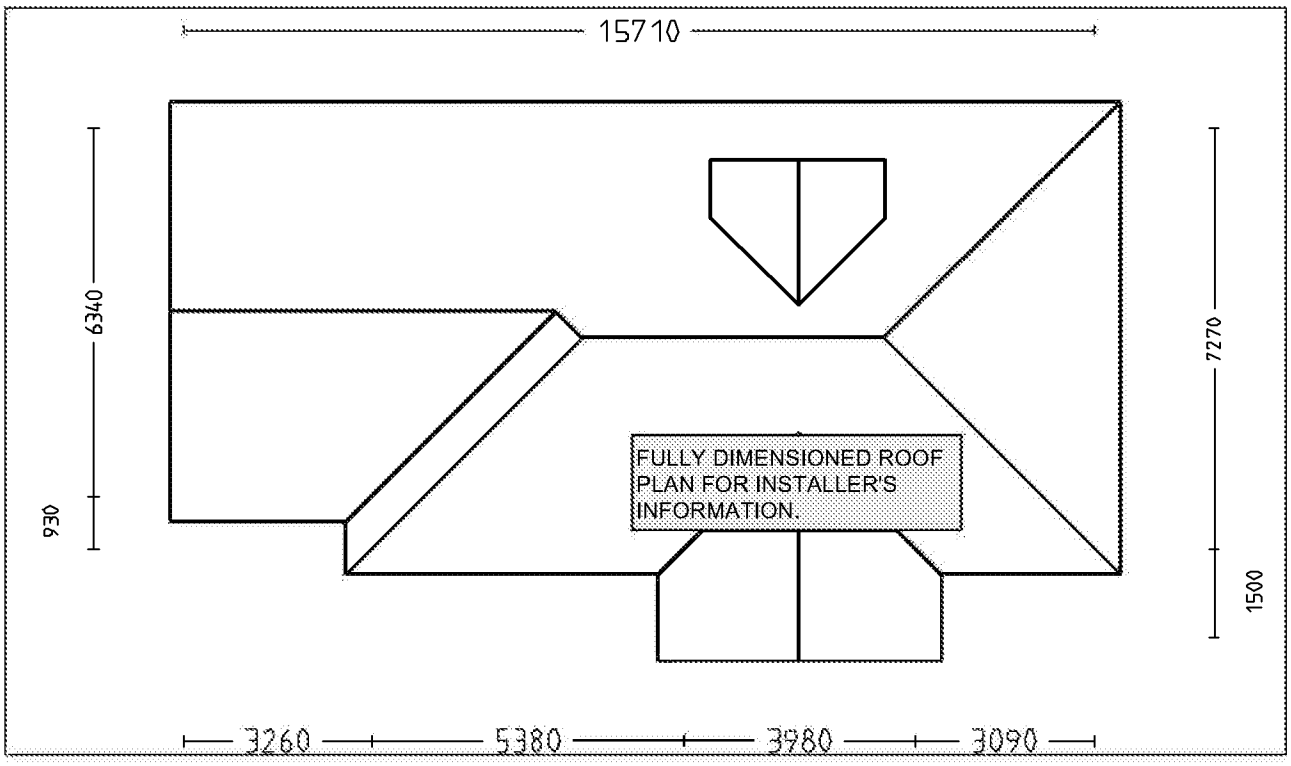
ROOFING PAY SUMMARY/INSTALLER SUMMARY:
TO BE USED BY THE SITE FOREMAN/INSTALLER
THIS REPORT GIVES THE QTY OF MATERIAL
DELIVERED TO THE SITE AND THE RATE THAT
MATERIAL COSTS TO INSTALL.

Contractor
Builder
Site Address

Item description	Qty	Rate	Total	Item description	Qty	Rate	Total
Straight roofing [BHP-2] sqm	152.47	1.00	152.47	Roof removal	0.00	2.00	0.00
Insulation sqm	0.00	1.00	0.00	Gutter removal	0.00	5.00	0.00
Ridges/Hips m	37.19	1.00	37.19	Siding removal	0.00	2.00	0.00
Valley m	0.00	1.00	0.00	Trim removal	0.00	5.00	0.00
Fascia only m	0.00	1.00	0.00	User lengths	0.00	1.00	0.00
Gutter only m	0.00	1.00	0.00	Pitch allowance	1.00	0.00	0.00
Fascia as Barge m	16.68	1.00	16.68	External cnr m	0.00	0.00	0.00
Fascia and gutter m	41.94	1.00	41.94	Internal cnr m	0.00	0.00	0.00
Barge m	16.68	1.00	16.68	Window sill m	0.00	0.00	0.00
Apron\Step m	0.00	1.00	0.00	Window head m	0.00	0.00	0.00
Chimneys ea	0.00	1.00	0.00	Window edge m	0.00	0.00	0.00
Box gutter m	0.00	1.00	0.00	Door edge m	0.00	0.00	0.00
Battens m	0.00	1.00	0.00	Door head m	0.00	0.00	0.00
DownPipes ea	0.00	7.00	0.00				

264.96

SMART TIP
THE SOFTWARE LOOKS AT WHAT STOREY ROOF YOU ARE ESTIMATING AND TAKES INTO ACCOUNT THE PITCH/SLOPE OF THE ROOF WHEN CALCULATING WHAT TO CHARGE FOR THE INSTALLATION.



17 September 2002

Applicad Roofing

Quotation Cutting List

ACN: Note 1
123 Church St
Hawthorn
03 9819 3100
03 9819 3200

Job number
Order number
Delivery date 17 September 2002

Category	Item description	Qty
Straight	Corrugated 0.42, Galvanised 32/4812, 13/4299, 4/2997	169.06
Ridge	BHP Ridge capping, Merino 1/6630, 3/6090, 1/5180, 1/3940, 1/2500, 1/700	37.22
Fascia	Metal fascia, Stone 3/8180, 1/5380, 1/3090, 1/3010, 2/1500, 2/1000, 1/930, 2/4000, 2/2700, 2/1660	58.67
Gutter	O Gee Gutter, Smooth Cream 3/8180, 1/5380, 1/3090, 1/3010, 2/1500, 2/1000, 1/930	41.95
Barge	Rake flashing, Smooth Cream 2/4000, 2/2700, 2/1660	16.72

HOW TO READ:
e.g. 3/8180
indicates 3 lengths to be cut at 8180 long. This is taking into account your lap-allowance etc. Rounding is done to the nearest 10/100mm.

QUOTATION CUTTING LIST
WHEN GENERATING THE QUOTATION CUTTING LIST THE SOFTWARE TAKES INTO ACCOUNT THE RUN ALLOWANCE AND LAP ALLOWANCE ON EACH FLASHING AS PER YOUR SETTINGS. FROM THIS THE SOFTWARE AUTOMATICALLY CREATES THE CUTTING DETAILS FOR THE FLASHINGS.
HAVING A RUN ALLOWANCE ON FLASHINGS, FOR EXAMPLE GUTTERING, ALLOWS ADDITIONAL MATERIAL FOR THE INSTALLER TO FABRICATE THE ENDS AND CORNERS.

Applicad Roofing

Note 2

Note 1

Phone 03 9819 3100
Fax 03 9819 3200

123 Church St
Hawthorn

Purchase Order - 1

Date 17 September 2002
Job
Site

FOR EACH SUPPLIER ON THE 'QUOTATION DETAILS FORM' AN ORDER FORM IS AUTOMATICALLY GENERATED.

Please supply the following in good order and condition :

Delivery Date 17 September 2002

ITEM	QTY	PRICE
Straight Roofing : BHP, BHP-2,Corrugated 0.42, Galvanised	**169.06**	
Ridge Flashing : BHP, BHPRC1,BHP Ridge capping, Merino	**37.22**	
1/6630, 3/6090, 1/5180, 1/3940, 1/2500, 1/700		
Fascia : BHP, FBHT42CTL--,Metal fascia, St		
3/8180, 1/5380, 1/3090, 1/3010, 2/1500, 2/100		
Gutter : BHP, OG60--,O Gee Gutter, Smooth		
3/8180, 1/5380, 1/3090, 1/3010, 2/1500, 2/1000, 1/930		
Barge : BHP, CBVCTL--,Rake flashing, Smooth Cream	**16.72**	
2/4000, 2/2700, 2/1660		
Accessory : BHP, FB-1,Fascia bracket,Stone	**47.00**	
Accessory : BHP, SC-1,Snap clip,Stone	**47.00**	
Accessory : BHP, EB-1,External bracket,Smooth Cream	**47.00**	
Accessory : BHP, EXCNR-90,External corner 90,Smooth Cream	**3.00**	
Accessory : BHP, INTCNR-90,Internal Corner 90,Smooth Cream	**3.00**	
Accessory : BHP, SE-L,Stop end left,Smooth Cream	**4.00**	
Accessory : BHP, SE-R,Stop end right,Smooth Cream	**8.00**	
Fasteners : BHP, BHFP1265HT17,12x65,Hex Head type 17,Galvanised	**1015.00**	
Fasteners : BHP, BHFP1265HT17,12x65,Hex Head type 17,Merino	**19.00**	
Fasteners : BHP, BHFP1265HT17,12x65,Hex Head type 17,Stone	**30.00**	
Fasteners : BHP, BHFP1265HT17,12x65,Hex Head type 17,Smooth Cream	**38.00**	

SICK OF ORDERING YOUR MATERIALS MANUALLY? FIND YOURSELF RUNNING OUT OF STOCK EVERY NOW AND THEN? THIS IS THE EXACT AMOUNT THAT IS REQUIRED FOR YOUR ROOF.

ACCESSORY ITEMS:
CLIPS, FASTENERS, BRACKETS
ALL AUTOMATICALLY REPORTED

Page 1 of 1

Signed _____

Tax Invoice

Applicad Roofing
ABN: 777-777-777-777

123 Church St
Hawthorn

Date: 17 September 2002

To:

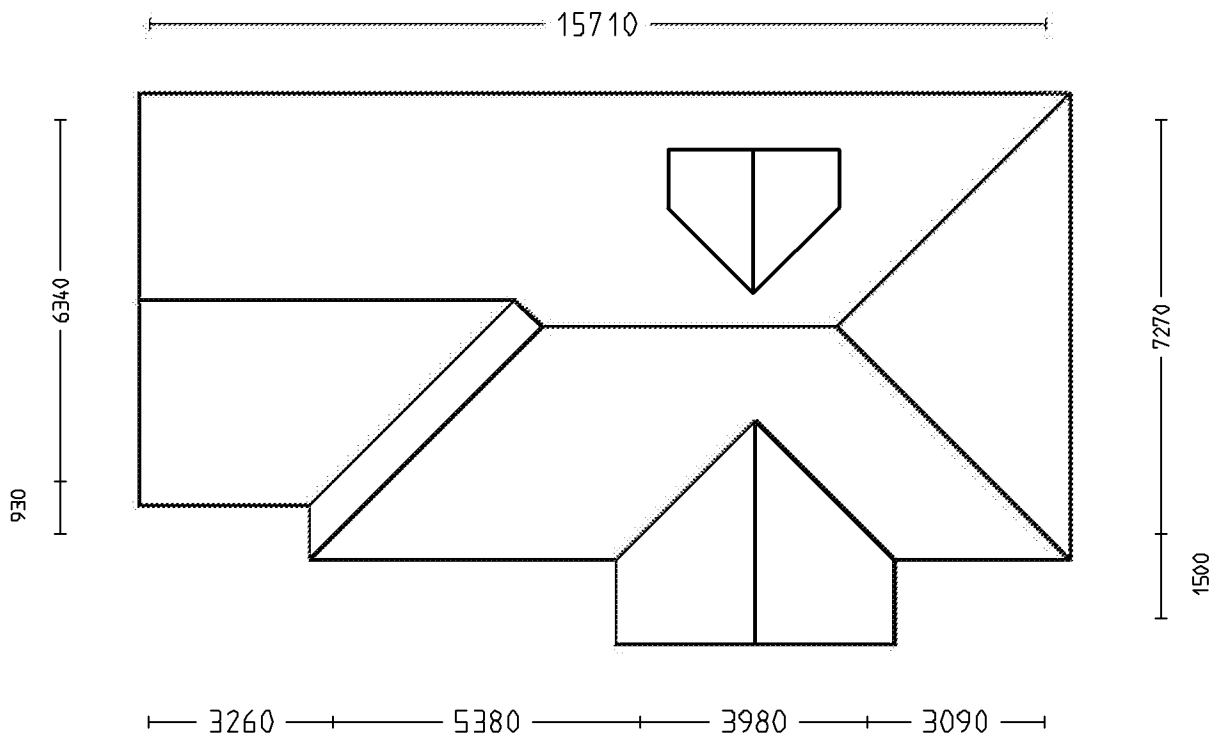
Site :

Qty	Description	Total
1	For the supply of materials.	$1193.56
Total Price Includes GST		$1193.56

Applicad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200

GENERAL ROOF PLAN SHOWING ALL DIMENSIONS



Roof details	
Roof Pitch	25.0
Height	2700
Rafter CTS	600
Eaves	450

Roof Plan

Job
Date 17 September 2002
Scale 1 :.125

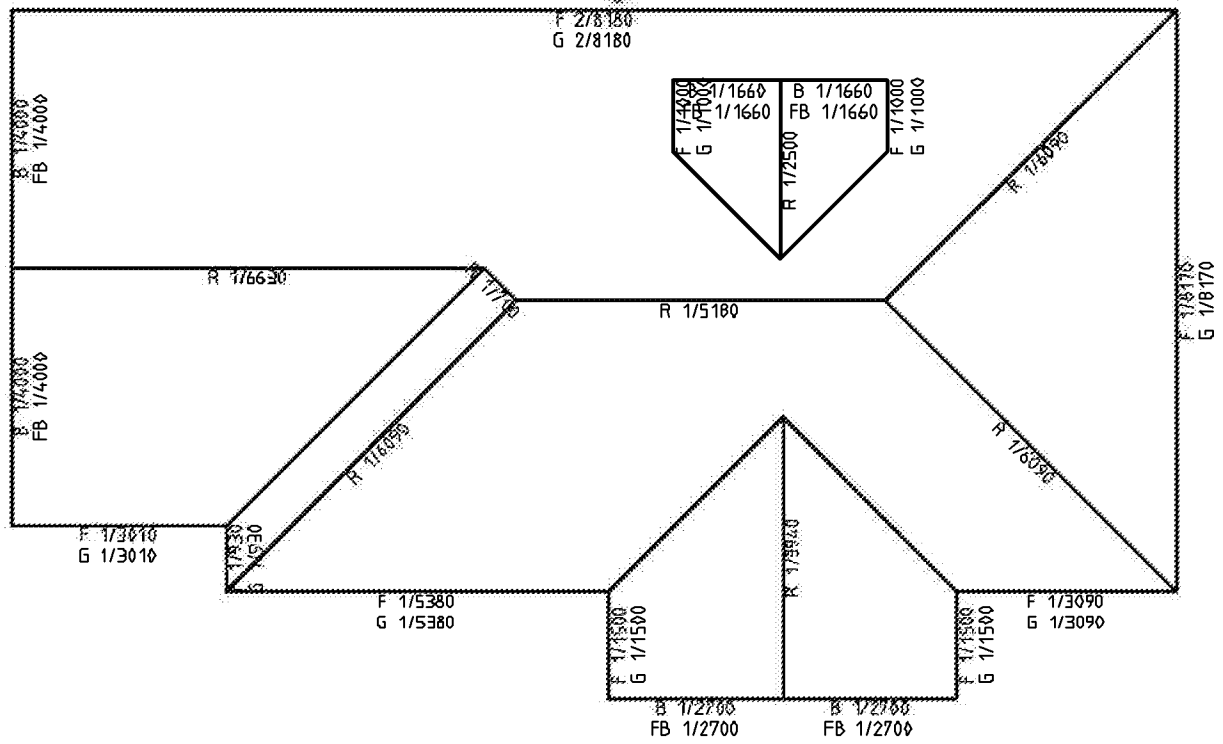
Site address

Sorcerer File : MetalTut.DAB Model : mod1

Applicad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200

FLASHING PLAN:
F 2/8180 - 2 LENGTHS OF FASCIA CUT AT 8180
G 2/8180 - 2 LENGTHS OF GUTTER CUT AT 8180



Ridge, BHP Ridge capping, Merino
1/6630, 3/6090, 1/5180, 1/3940, 1/2500, 1/700,

Fascia, Metal fascia, Stone
3/8180, 1/5380, 1/3090, 1/3010, 2/1500, 2/1000, 1/930,

Gutter, O Gee Gutter, Smooth Cream
3/8180, 1/5380, 1/3090, 1/3010, 2/1500, 2/1000, 1/930,

Barge, Rake flashing, Smooth Cream
2/4000, 2/2700, 2/1660,

FasciaAsBarge, Metal fascia, Stone
2/4000, 2/2700, 2/1660,

Roof details

Roof Pitch	25.0
Height	2700
Rafter CTS	600
Eaves	450

Flashing Plan

Site address

Job
Date 17 September 2002
Scale 1 : 100

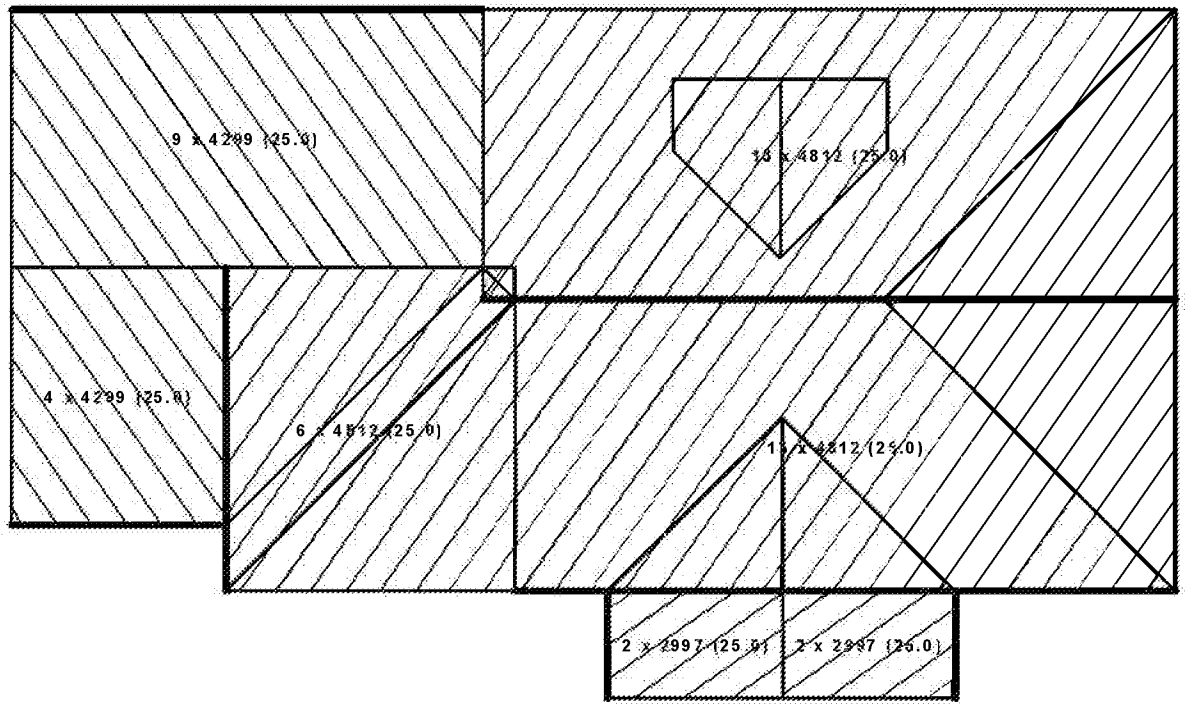
Sorcerer File : MetalTut.DAB Model : mod1

2181

Applicad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200

BLOCKING PLAN
SHOWS THE NUMBER, POSITION AND LENGTHS OF SHEETS BEING INSTALLED ON THE ROOF.



BHP, Corrugated 0.42, Galvanised
32 / 4812 13 / 4299 4 / 2997

32/4812
32 SHEETS CUT AT 4812

Roof details

Roof Pitch	25.0
Height	2700
Rafter CTS	600
Eaves	450

Block Plan

Site address

Job
Date 17 September 2002
Scale 1 :.100

Sorcerer File : MetalTut.DAB Model : mod1

2182

Roof Wizard

Especially suited to metal roofing.



Generate Offcuts Reports

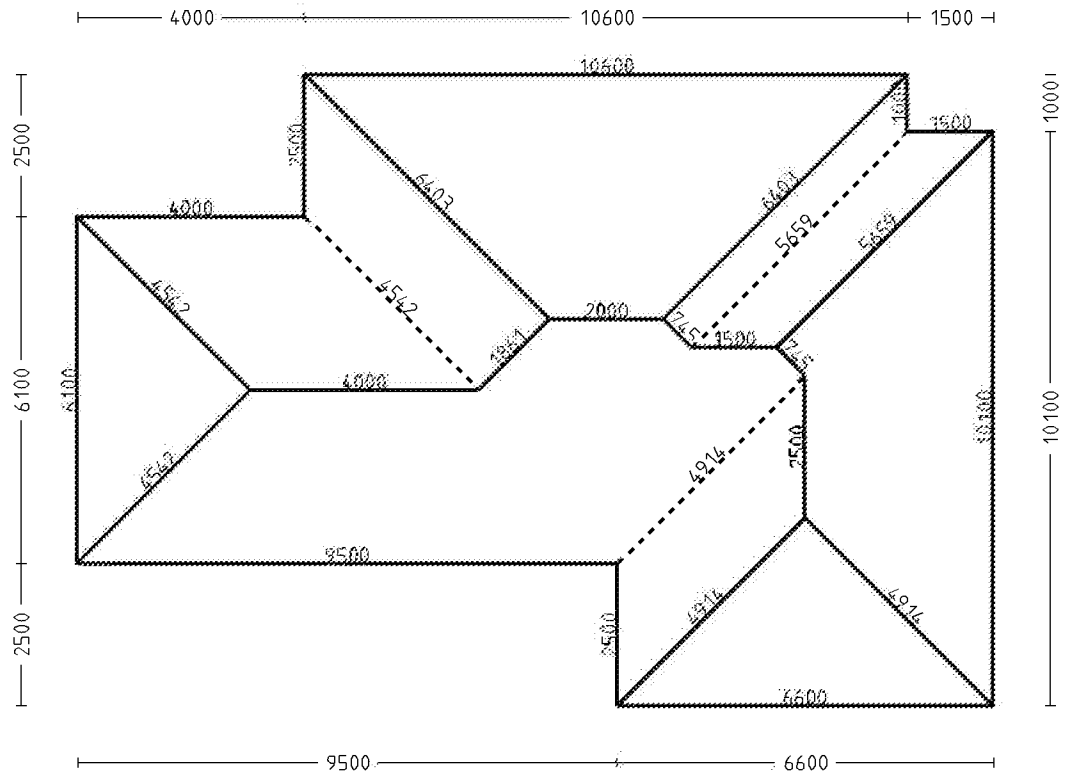
Example of metal roof panel optimisation output

appli-cad
Australia

AppliCad Roofing

70 Railway Road
Blackburn

Phone 03 9819 3100
Fax 03 9819 3200



Roof details	
Roof Pitch	25.0
Height	3200
Rafter CTS	900
Eaves	0

Roof Plan

Site address

Job

Date 14 September 2006

Scale 1 : 125

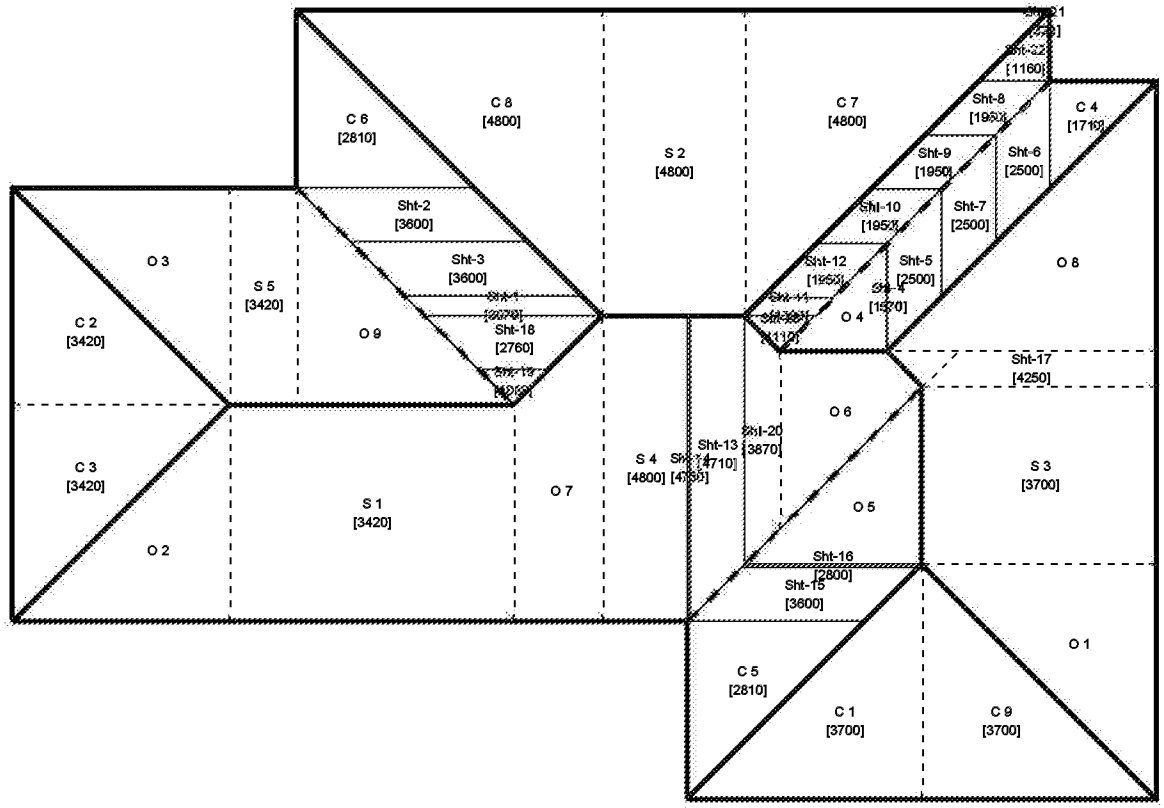
Sorcerer + Warlock File : OffcutsMetricReports.DXB Version 6.1

2184

This quotation was prepared using AppliCad software.

AppliCad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200



BHP, Corrugated 0.42, Galvanised
1 / 7050 1 / 6940 1 / 6420 1 / 6360 1 / 5810
1 / 5570 1 / 5520 14 / 4800 1 / 4710 1 / 3870
12 / 3700 15 / 3420 7 / 2810 2 / 1710

2185

Sorcerer File : GenRoofTest.dab Model : m1

Roof details	
Roof Pitch	25.0
Height	6500
Rafter CTS	900
Eaves	300

Offcut Layout Guide

Job
Date 9 March 2005
Scale 1 : 100

Site address

AppliCad Roofing

123 Church St Phone 03 9819 3100
Hawthorn Fax 03 9819 3200

BHP, BHP-2, Corrugated 0.42, Galvanised

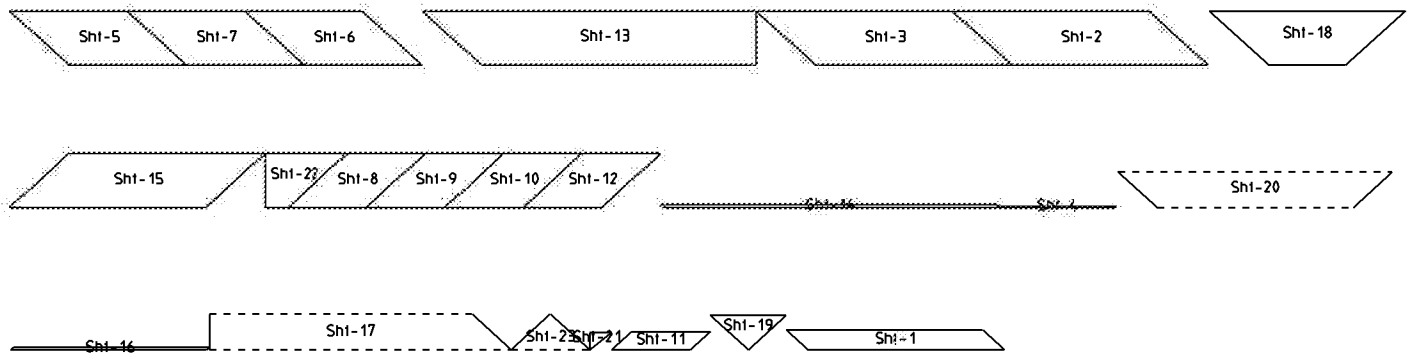
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Sht-7	2500	Sht-13	4710	Sht-14	4750	Sht-20	3870
Sht-17	4250	Sht-15	3600	Sht-16	2800	Sht-1	3070
Sht-2	3600	Sht-3	3600	Sht-18	2760	Sht-19	1080
Sht-8	1950	Sht-9	1950	Sht-10	1950	Sht-11	1390
Sht-12	1950	Sht-21	320	Sht-22	1160	Sht-23	1110

BHP, BHP-2, Corrugated 0.42, Galvanised

Code	Length	Code	Length	Code	Length	Code	Length
		S1	5.1/3420	S2	2.3/4800	S3	2.6/3700
S4	0.4/4800	S5	1.2/3420	C1/O1	4.3/3700	C2/O2	4.0/3420
C3/O3	4.0/3420	C4/O4	2.0/1710	C5/O5	3.3/2810	C6/O6	3.3/2810
C7/O7	5.6/4800	C8/O8	5.6/4800	C9/O9	4.3/3700		

AppliCad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200



2187

Panel sequence Page 1 of

Job

Date 9 March 2005

Scale 1 : 100

Site address

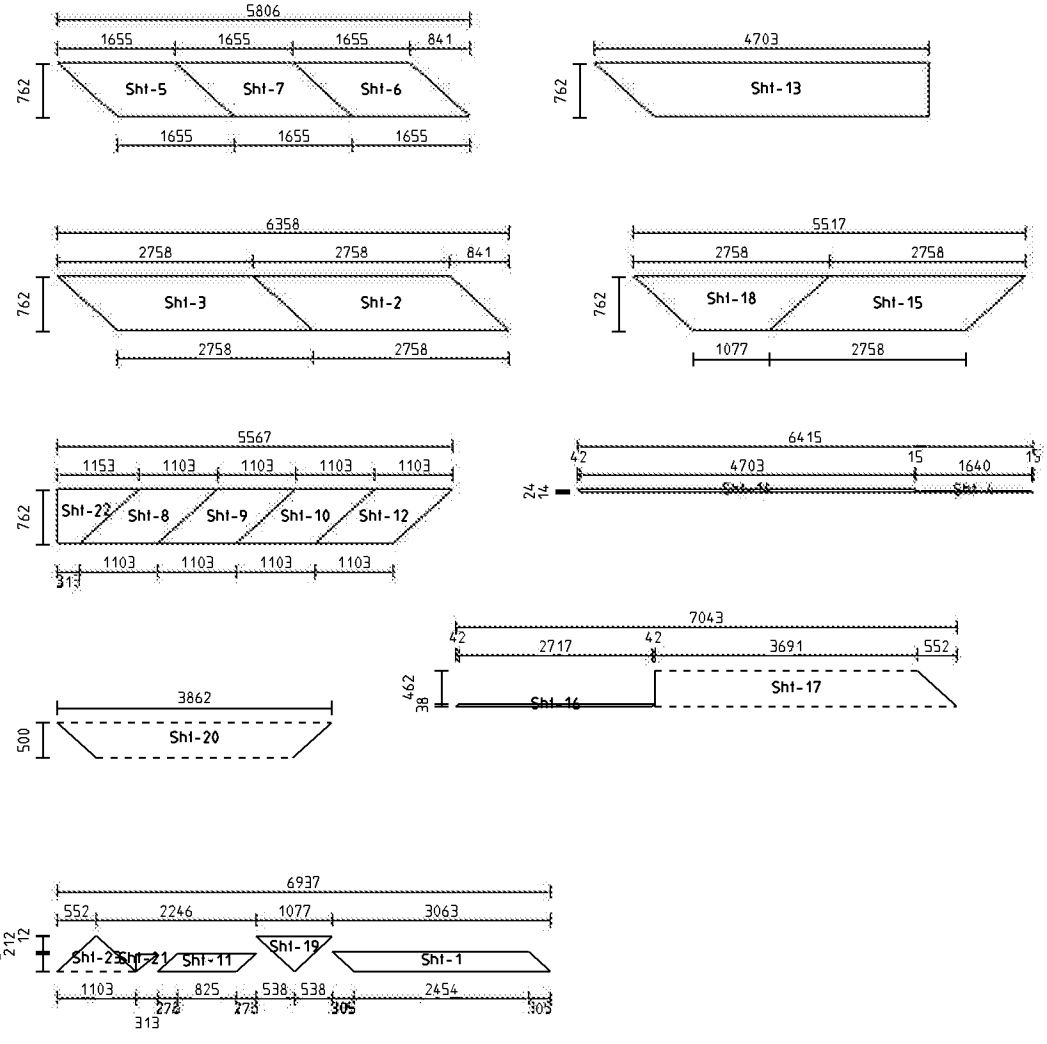
Sorcerer File : GenRoofTest.dab Model : m1

AppliCad Roofing

Sheet Cutting Details

ACN: Note 1
123 Church St
Hawthorn
03 9819 3100
03 9819 3200

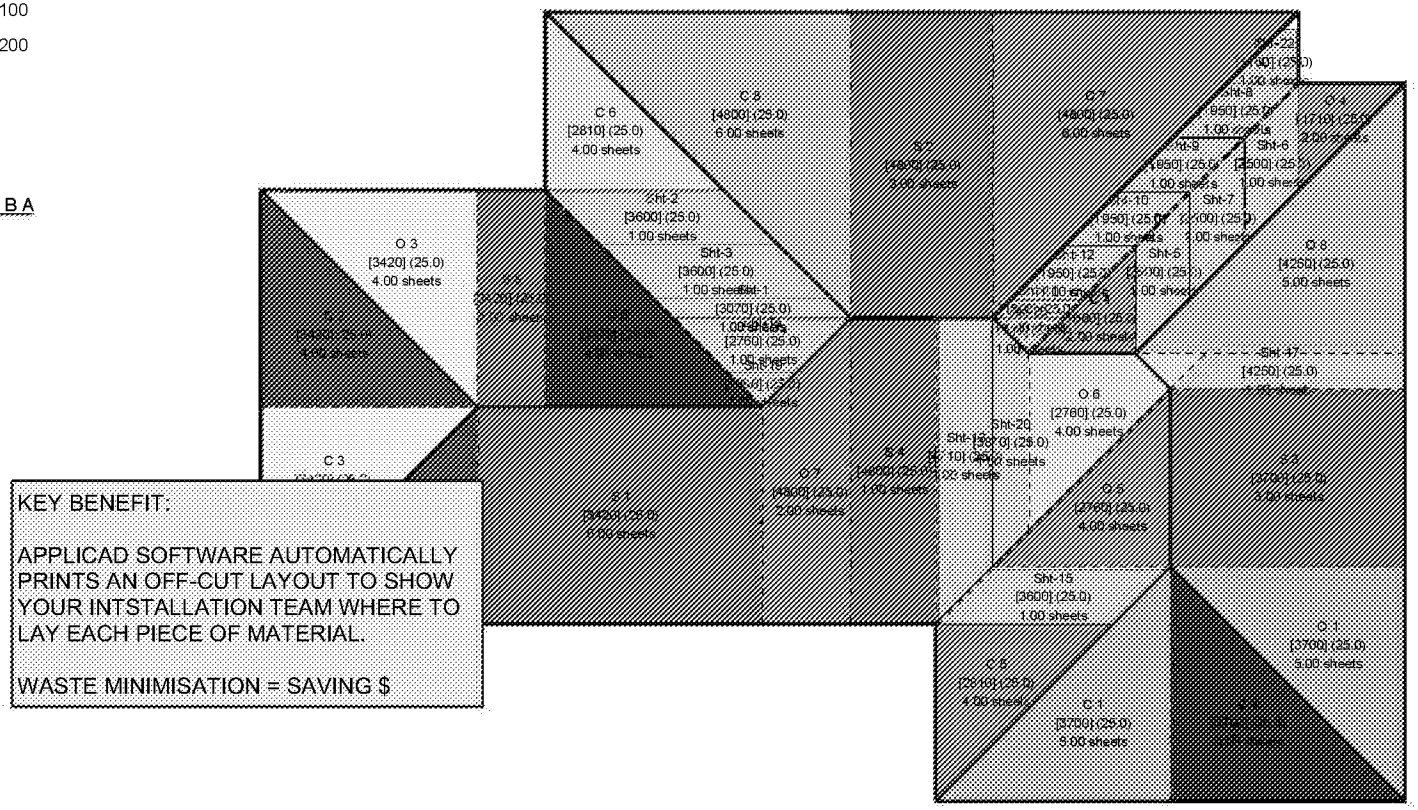
Contractor
Builder
Site Address



AppliCad Roofing

70 Railway Road Phone 03 9819 3100
Blackburn Fax 03 9819 3200

Bluescope Steel, Corrugated Colorbond, Colour T B A
1 / 20020 1 / 17450 1 / 13070 16 / 4800 13 / 3700
16 / 3420 8 / 2810 2 / 1660



KEY BENEFIT:

APPLICAD SOFTWARE AUTOMATICALLY PRINTS AN OFF-CUT LAYOUT TO SHOW YOUR INTSTALLATION TEAM WHERE TO LAY EACH PIECE OF MATERIAL.

WASTE MINIMISATION = SAVING $

2189

Roof details	
Roof Pitch	25.0
Height	3200
Rafter CTS	900
Eaves	0

Offcut Layout Guide (Colour)

Site address

Job
Date 14 September 2006
Scale 1 : 100

Sorcerer + Warlock File : OffcutsMetricReports.DAB Model : m1

This quotation was prepared using AppliCad software.

Roof Wizard

Especially suited to metal roofing.



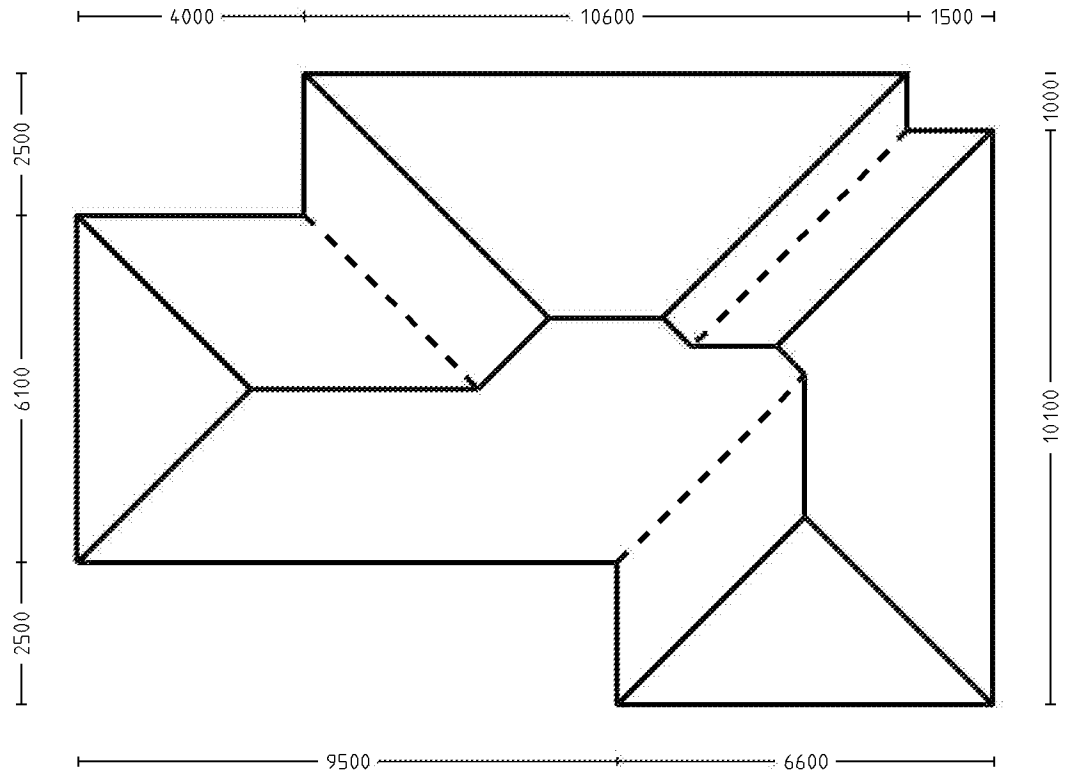
Generate Offcuts Reports

Example of metal roof panel optimisation output

appli-cad
Australia

AppliCad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200



Roof details	
Roof Pitch	25.0
Height	6500
Rafter CTS	900
Eaves	300

Roof Plan

Job
Date 9 March 2005
Scale 1 : 125

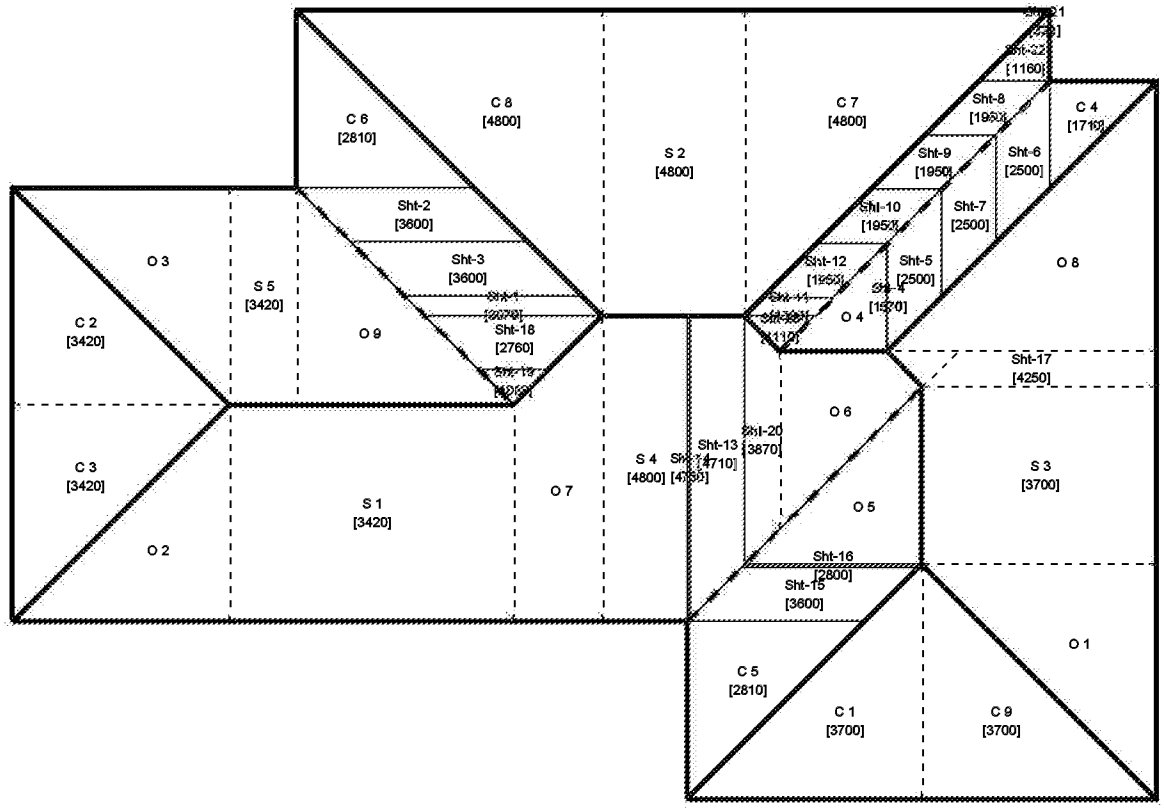
Site address

Sorcerer File : GenRoofTest.dab Model : m1

2191

AppliCad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200



BHP, Corrugated 0.42, Galvanised
1 / 7050 1 / 6940 1 / 6420 1 / 6360 1 / 5810
1 / 5570 1 / 5520 14 / 4800 1 / 4710 1 / 3870
12 / 3700 15 / 3420 7 / 2810 2 / 1710

2192

Roof details	
Roof Pitch	25.0
Height	6500
Rafter CTS	900
Eaves	300

Offcut Layout Guide

Job
Date 9 March 2005
Scale 1 : 100

Site address

Sorcerer File : GenRoofTest.dab Model : m1

AppliCad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200

BHP, BHP-2, Corrugated 0.42, Galvanised

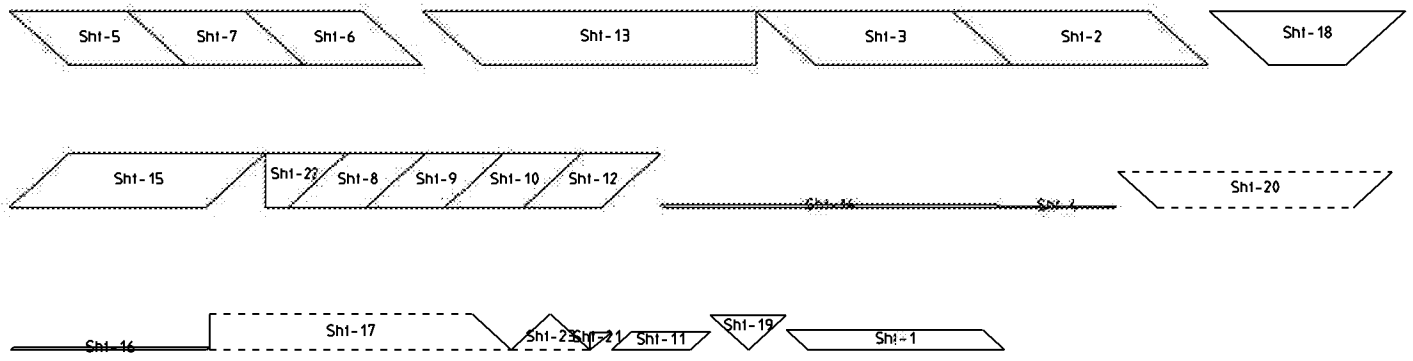
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Sht-7	2500	Sht-13	4710	Sht-14	4750	Sht-20	3870
Sht-17	4250	Sht-15	3600	Sht-16	2800	Sht-1	3070
Sht-2	3600	Sht-3	3600	Sht-18	2760	Sht-19	1080
Sht-8	1950	Sht-9	1950	Sht-10	1950	Sht-11	1390
Sht-12	1950	Sht-21	320	Sht-22	1160	Sht-23	1110

BHP, BHP-2, Corrugated 0.42, Galvanised

Code	Length	Code	Length	Code	Length	Code	Length
		S1	5.1/3420	S2	2.3/4800	S3	2.6/3700
S4	0.4/4800	S5	1.2/3420	C1/O1	4.3/3700	C2/O2	4.0/3420
C3/O3	4.0/3420	C4/O4	2.0/1710	C5/O5	3.3/2810	C6/O6	3.3/2810
C7/O7	5.6/4800	C8/O8	5.6/4800	C9/O9	4.3/3700		

AppliCad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200



2194

Panel sequence Page 1 of

Job

Date 9 March 2005

Scale 1 : 100

Site address

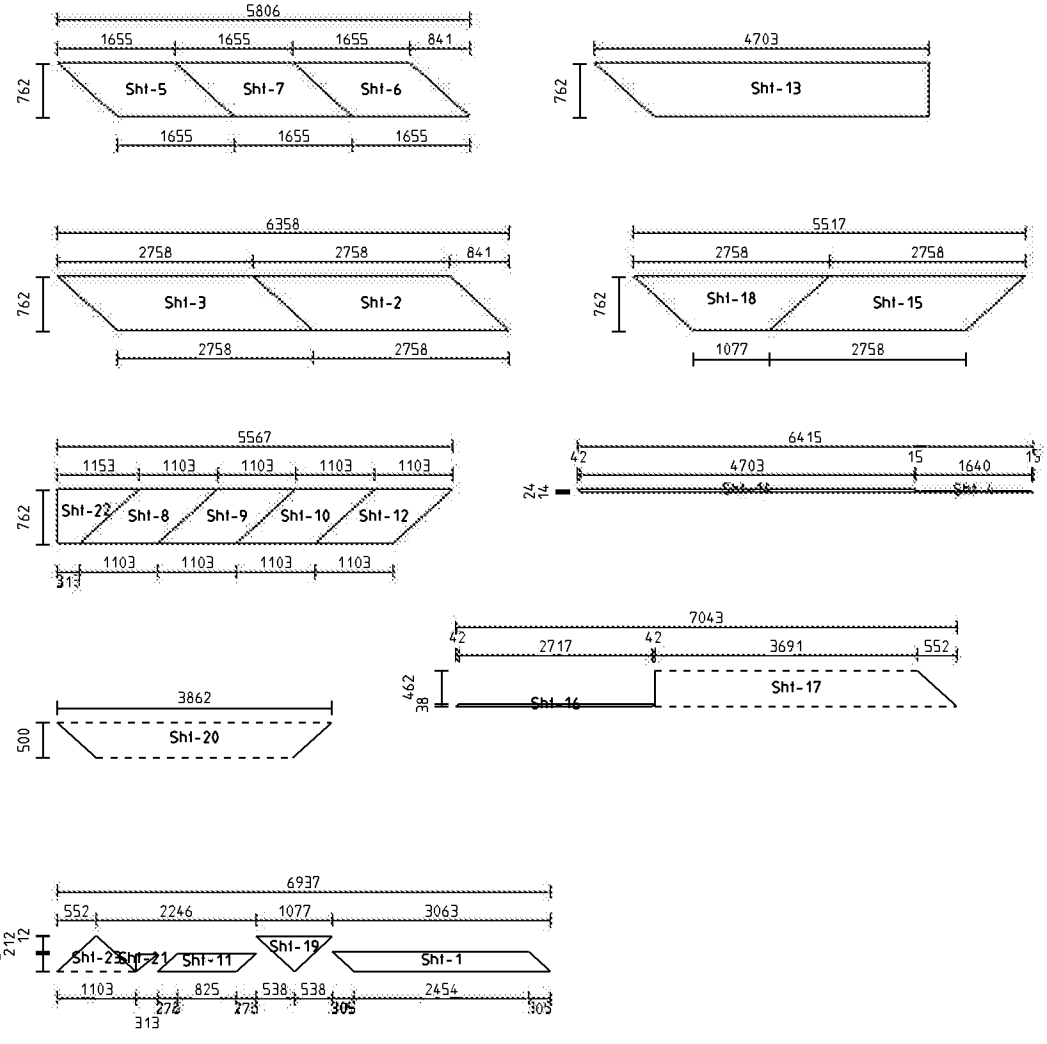
Sorcerer File : GenRoofTest.dab Model : m1

AppliCad Roofing

Sheet Cutting Details

ACN: Note 1
123 Church St
Hawthorn
03 9819 3100
03 9819 3200

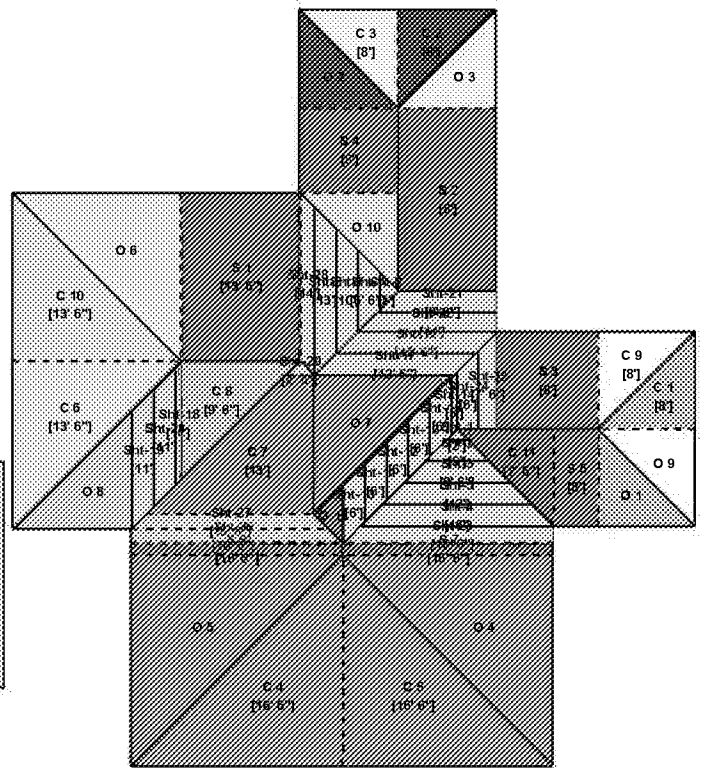
Contractor
Builder
Site Address



Applicad Roofing

123 Church St
Hawthorn
Phone 03 9819 3100
Fax 03 9819 3200

BHP, Corrugated 0.42imp, TBA
2 / 29' 6" 1 / 29' 1 / 28' 6" 1 / 28' 1 / 27' 6"
1 / 25' 1 / 18' 6" 22 / 16' 1" 22 / 13' 1" 7 / 13'
1 / 12' 6 / 9' 1" 41 / 8' 5 / 7' 1" 1 / 7' 6"



KEY BENEFIT:

APPLICAD SOFTWARE AUTOMATICALLY PRINTS AN OFF-CUT LAYOUT TO SHOW YOUR INTSTALLATION TEAM WHERE TO LAY EACH PIECE OF MATERIAL.

WASTE MINIMISATION = SAVING $

2196

Roof details

Roof Pitch	5.6 in 12
Height	10' 2 1/4"
Rafter CTS	1' 11 3/4"
Eaves	1' 5 3/4"

Offcut Layout Guide (Colour)

Job
Date 30 September 2005
Scale 1 : 150

Site address

Sorcerer + Warlock File : offcuttest.dab Model : mod4

Low slope
Steep slope
Re-roof
New roof
Residential
Commercial
Industrial
Metal
Shingles
Tiles
Slate
BUR
Single ply
Low slope
Steep slope
Re-roof
New roof
Residential
Commercial
Industrial
Metal
Shingles
Tiles
Slate
BUR
Single ply
Low slope
Steep slope
Re-roof
New roof
Residential
Commercial

AppliCad
USA
Sample Reports



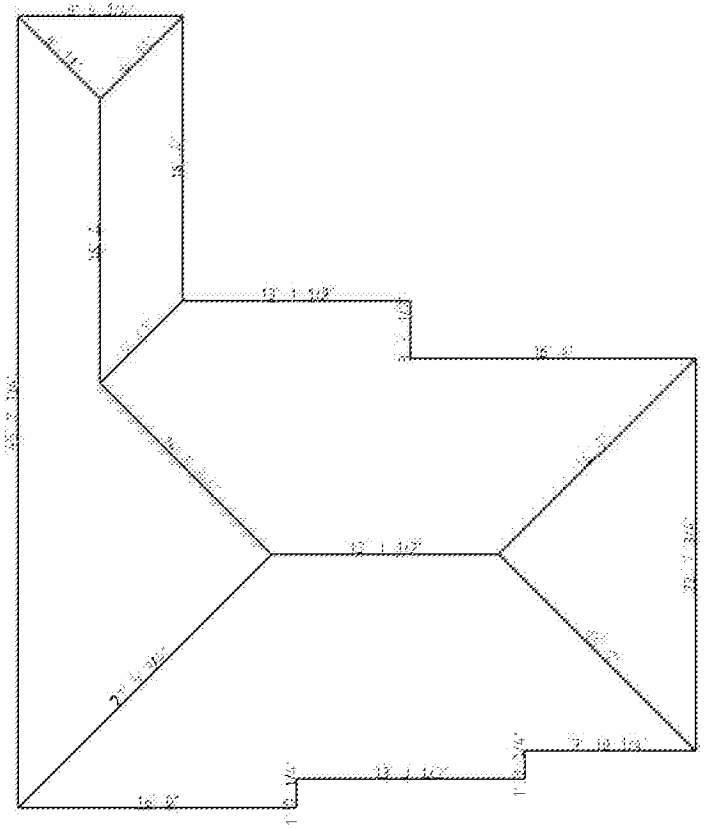
Linear Nesting Reports

1. Roof Drawing
2. Sheet Layout Drawing
3. Sheet Cutting List
4. Sheet Cutting Details(Page 1 of 3)
5. Sheet Cutting Details(Page 2 of 3)
6. Sheet Cutting Details(Page 3 of 3)
7. Panel Sequence(Page 1 of 2)
8. Panel Sequence(Page 2 of 2)

appli-cad

Roofs R Us

357 Magnum Drive
Phone 03 9524 8217
Fax 03 9524 2468



Roof Wizard File : John Doe\Ish Model : JRS-RW-RCCF1

2198

Roof details

Roof Pitch	4.8 in 12
Height	8' 10 1/2"
Rafter CTS	1' 11 3/4"
Eaves	1' 5 3/4"

Roof Plan

Site address

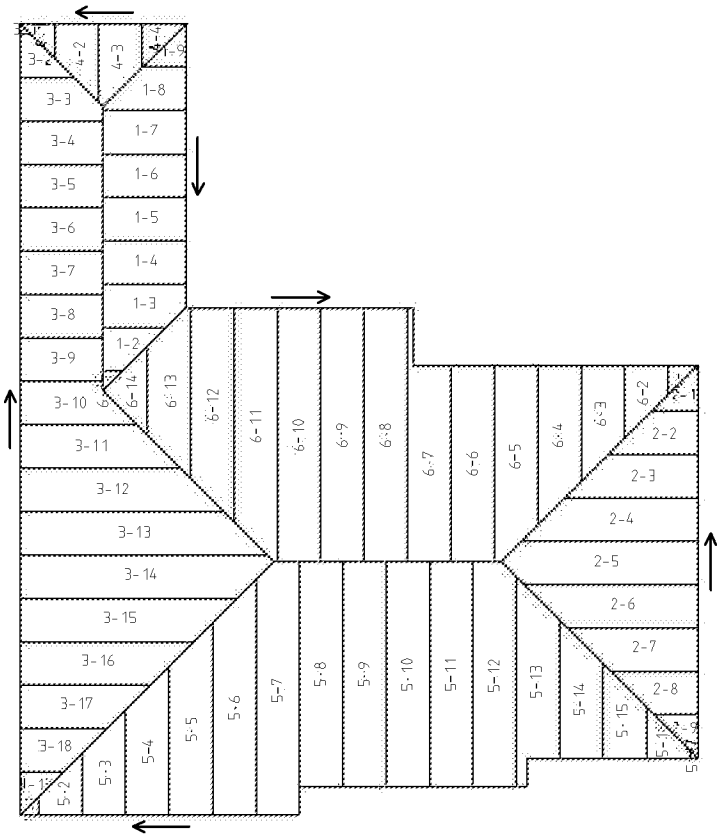
Job

Date 25 November 1999

Scale 1 : 4

Roofs R Us

357 Magnum Drive
Phone 03 9524 8217
Fax 03 9524 2468



Sheet Layout

Job	584
Date	25 November 1999
Scale	1 : 125

Site address
13 Bellview Road
Chinton

Roof details

Roof Pitch	4.8 in 12
Height	8' 10 1/2"
Rafter CTS	1' 11 3/4"
Eaves	1' 5 3/4"

Roof Wizard File : John Doe cab Mods : 13 Bellview Road

2199

Roofs R Us

357 Magnum Drive
Phone 03 9524 8217
Fax 03 9524 2468

Code	Length	Code	Length	Code	Length	Code	Length	Code	Length	Code	Length
1-9	2' 9"	6-13	10' 7"								
1-8	5' 2"	6-12	13' 4"								
1-7	5' 2"	6-11	15' 9"								
1-6	5' 2"	6-10	15' 9"								
1-5	5' 2"	6-9	15' 9"								
1-4	5' 2"	6-8	15' 9"								
1-3	5' 2"	6-7	12' 3"								
1-2	4' 0"	6-6	12' 3"								
1-1	1' 3"	6-5	12' 3"								
2-9	2' 9"	6-4	10' 0"								
2-8	5' 5"	6-3	7' 3"								
2-7	8' 1"	6-2	4' 7"								
2-6	10' 10"	6-1	1' 11"								
2-5	12' 3"										
2-4	10' 11"										
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2-2	5' 7"										
2-1	2' 10"										
3-19	2' 9"										
3-18	5' 5"										
3-17	8' 1"										
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4-2	4' 11"										
4-1	2' 2"										
5-17	0' 6"										
5-16	3' 3"										
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5-5	12' 0"										
5-4	9' 3"										
5-3	6' 7"										
5-2	3' 11"										
5-1	1' 2"										
6-15	0' 2"										
6-14	5' 5"										

Roof Wizard File : John Doe.dab Model : 13 Bellview Road

Sheet list

Job 584
Date 25 November 1999
Scale 1 : 125

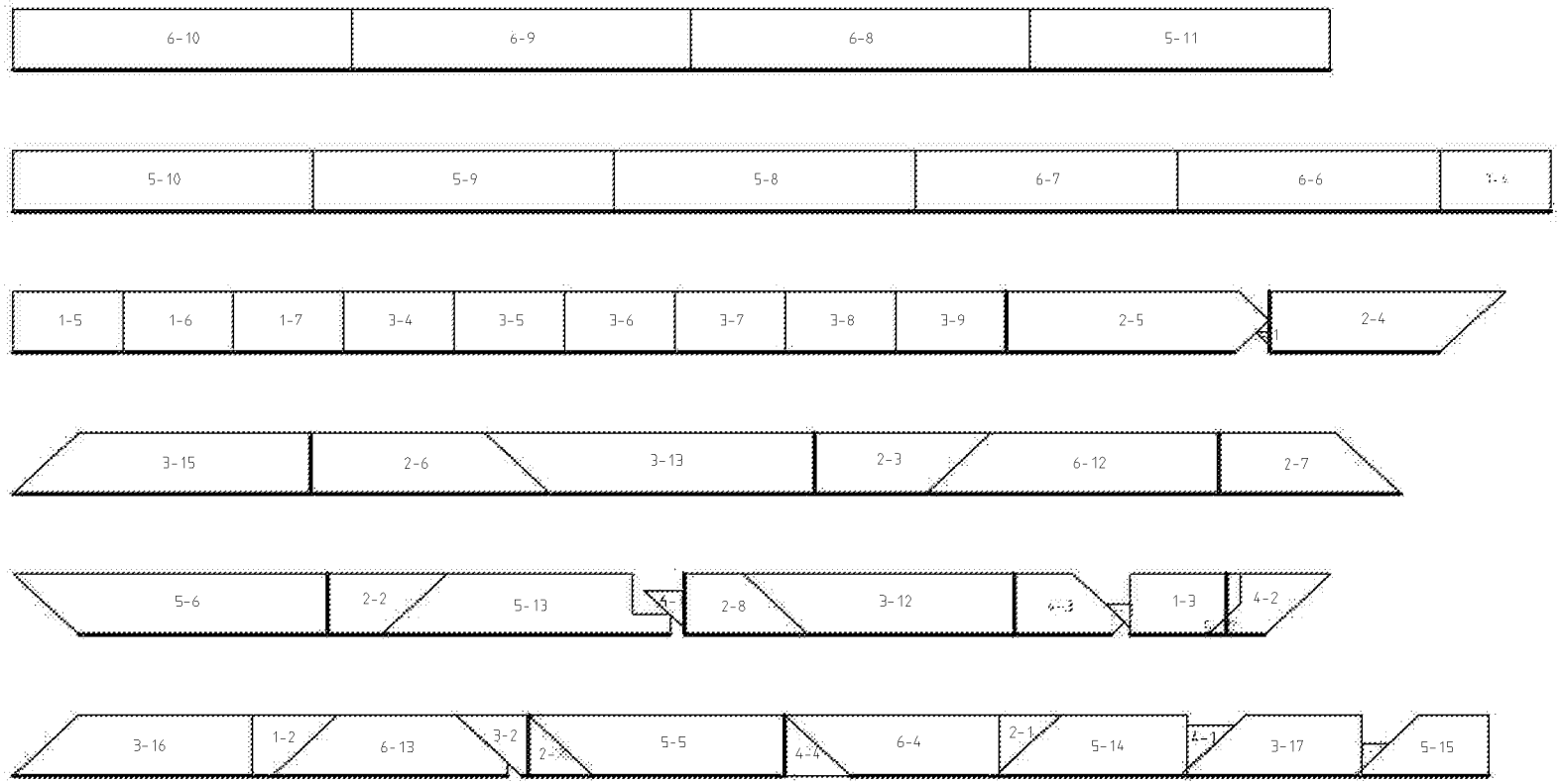
Site address
13 Bellview Road
Chinton

Roof details

Roof Pitch	4.8 in 12
Height	8' 10 1/2"
Rafter CTS	1' 11 3/4"
Eaves	1' 5 3/4"

Roofs R Us

357 Magnum Drive
Phone 03 9524 8217
Fax 03 9524 2468



2201

Panel sequence

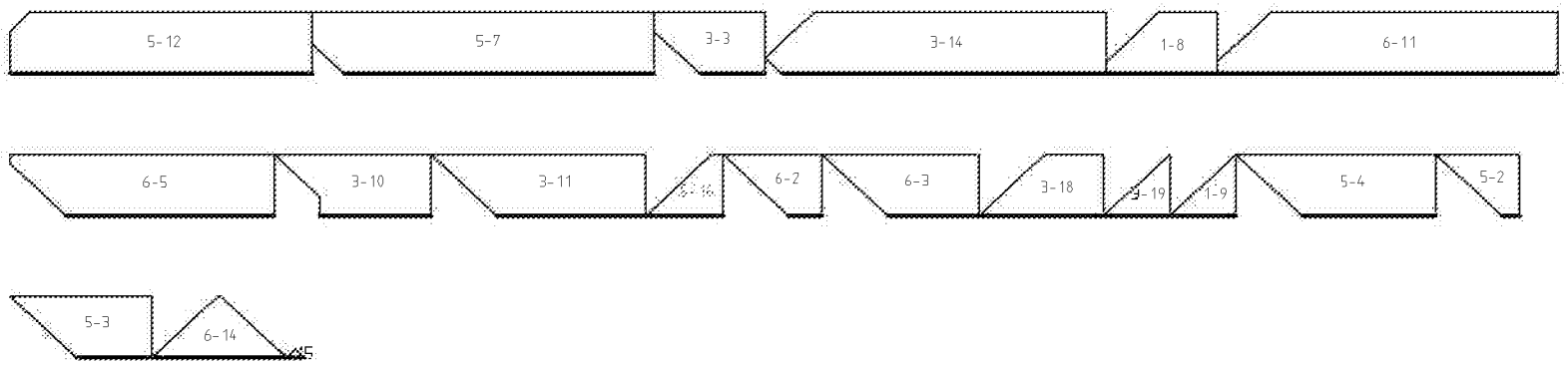
Job 584
Date 25 November 1999
Scale 1 : 100

Site address
13 Bellview Road
Chinton

Roof Wizard File : Jobs\584.daft Model : 13 Bellview Road

Roofs R Us

357 Magnum Drive
Phone 03 9524 8217
Fax 03 9524 2468



2202

Panel sequence

Job 584
Date 25 November 1999
Scale 1 : 100

Site address
13 Bellview Road
Chinton

Roof Wizard File : Jobs\584.daft Model : 13 Bellview Road

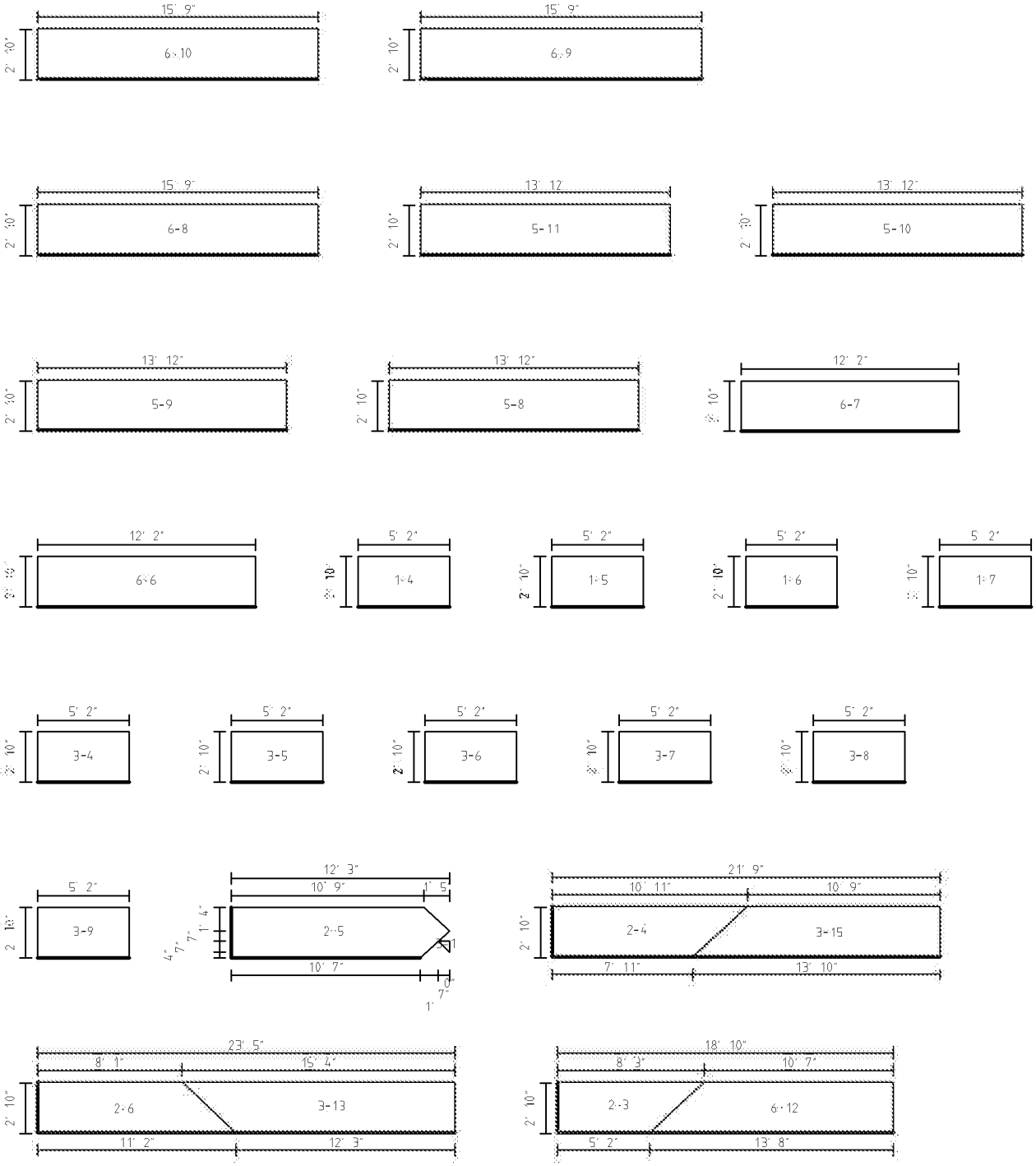
Roofs R Us
ACN: 245 896 348
357 Magnum Drive

03 9524 8217
03 9524 2468

25 November 1999

Sheet Cutting Details

Contractor	Ben Johnson
Builder	Builders Inc
Site Address	13 Bellview Road
	Chinton



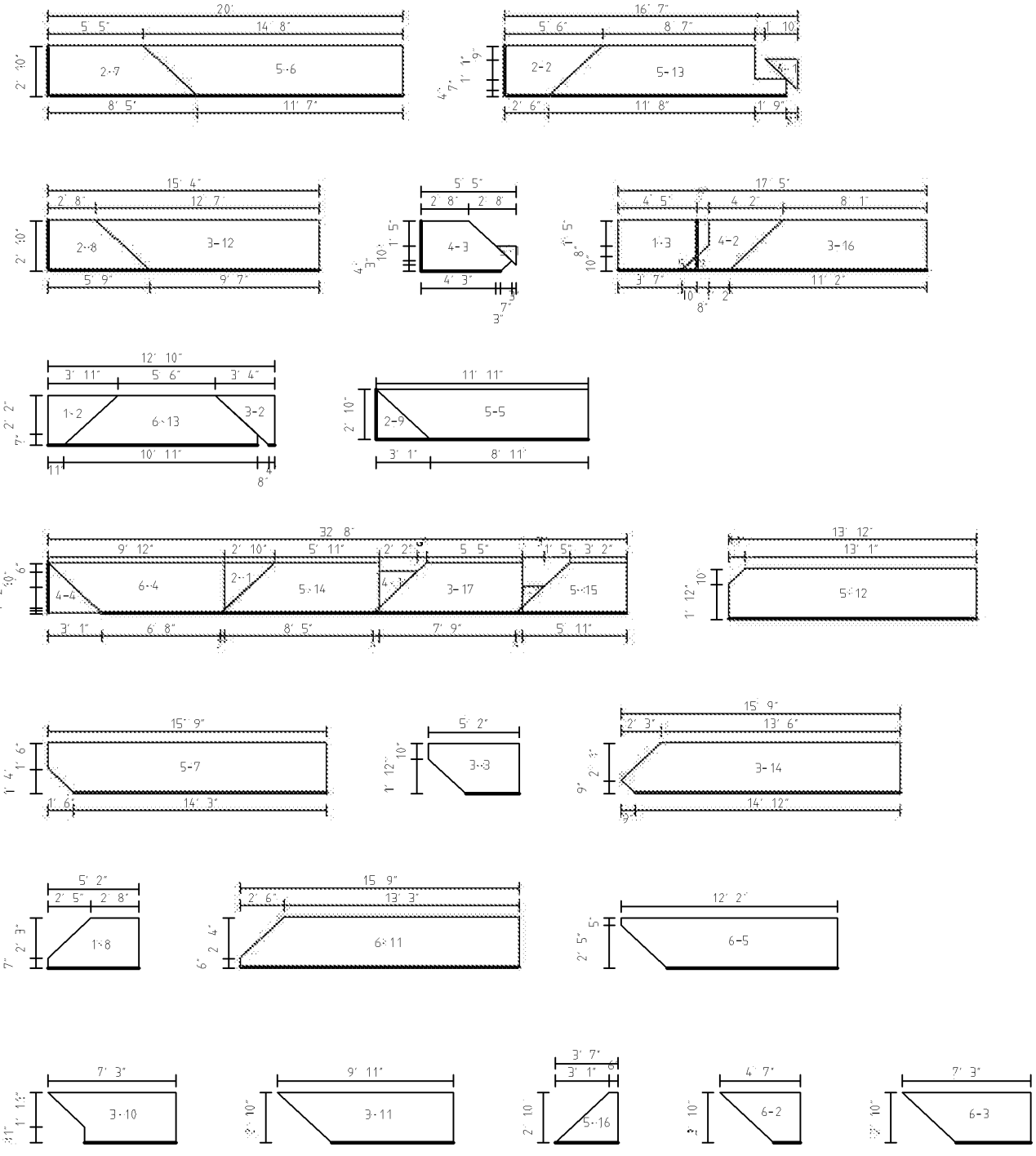
Roofs R Us
ACN: 245 896 348
357 Magnum Drive

03 9524 8217
03 9524 2468

Sheet Cutting Details

25 November 1999

Contractor	Ben Johnson
Builder	Builders Inc
Site Address	13 Bellview Road Chinton



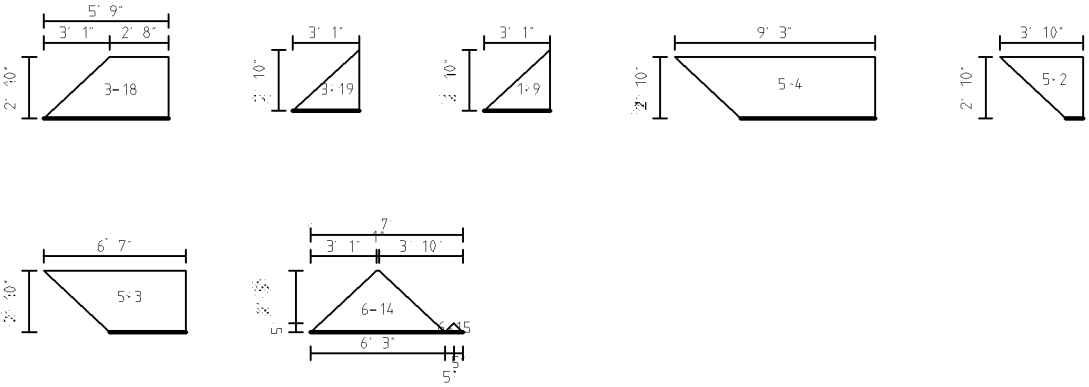
Roofs R Us
ACN: 245 896 348
357 Magnum Drive

03 9524 8217
03 9524 2468

Sheet Cutting Details

25 November 1999

Contractor Ben Johnson
Builder Builders Inc
Site Address 13 Bellview Road
Chinton



Product Overview

Sorcerer

incorporating Roof Master, Roof Wizard, Roof Magician, Roof Maestro

Advanced Software for Roofing Modeling, Estimating, Presentation and Installation

AppliCad
email: enquiries@applicad.com.au
http://www.applicad.com.au

Issue 5, 2 March 2001

INTRODUCTION

Australian software developers have a world-wide reputation for innovative and unique products. AppliCad is an application developer based in Melbourne, and they have proven once again that this is indeed the case. With the release of their software packages for roof modeling and estimation called ***Sorcerer***, they have hit new heights with functionality, ease of use and outstanding value for money.

The ***Sorcerer*** software is an integrated 3D CAD (Computer Aided Design) modeling system that takes full advantage of the powerful 3D capabilities. The ***Sorcerer*** software provides roof material estimators with a complete suite of tools for roofing design, estimating and presentation in three dimensions. The basic principle of ***Sorcerer*** is based upon a simple overview of the design process - ***Sorcerer*** works the way you do.

Sorcerer takes the chore out of roof modeling and estimating. The estimator gains immediate benefits in producing accurate models and precise quotations for a wide range of roof designs. A complete set of detailed forms is produced so that everyone involved in the process has a record of the proposed transaction.

The Justification
The successful roofing contractor is involved in many aspects of roof restoration and fabrication. The Contractor must have the most up to date technology to satisfy the customer's needs in a timely fashion with professional looking documentation that is accurate and reliable.

Wise investment in new technology is an imperative in today's competitive environment. Investments must demonstrate their value when viewed in terms of the 'cost benefit'. **Sorcerer** is such an effective set of programs it will pay for itself in just a few months on the basis of just one quotation a day.

Consider this:

Take a single job that would typically take say 35 minutes using traditional methods. The ***Sorcerer*** *has the technology that allows you to complete that same task in just 5 minutes - a saving of 30 minutes. Saving 30 minutes each day adds up to an amazing 100 hours over a year - on just one job a day!*
Even at modest hourly charge rates, ***any Sorcerer module will pay for itself quickly.***

Starting with the Roof Master for roof modeling to the complete solution of Sorcerer - *for low slope or steep slope; for residential or commercial/industrial* - AppliCad Australia has the most cost effective solutions for the professional roofing contractor or roofing material supplier.

What follows is a brief overview of the modeling and quoting process using our software. First of all let us look at the options.

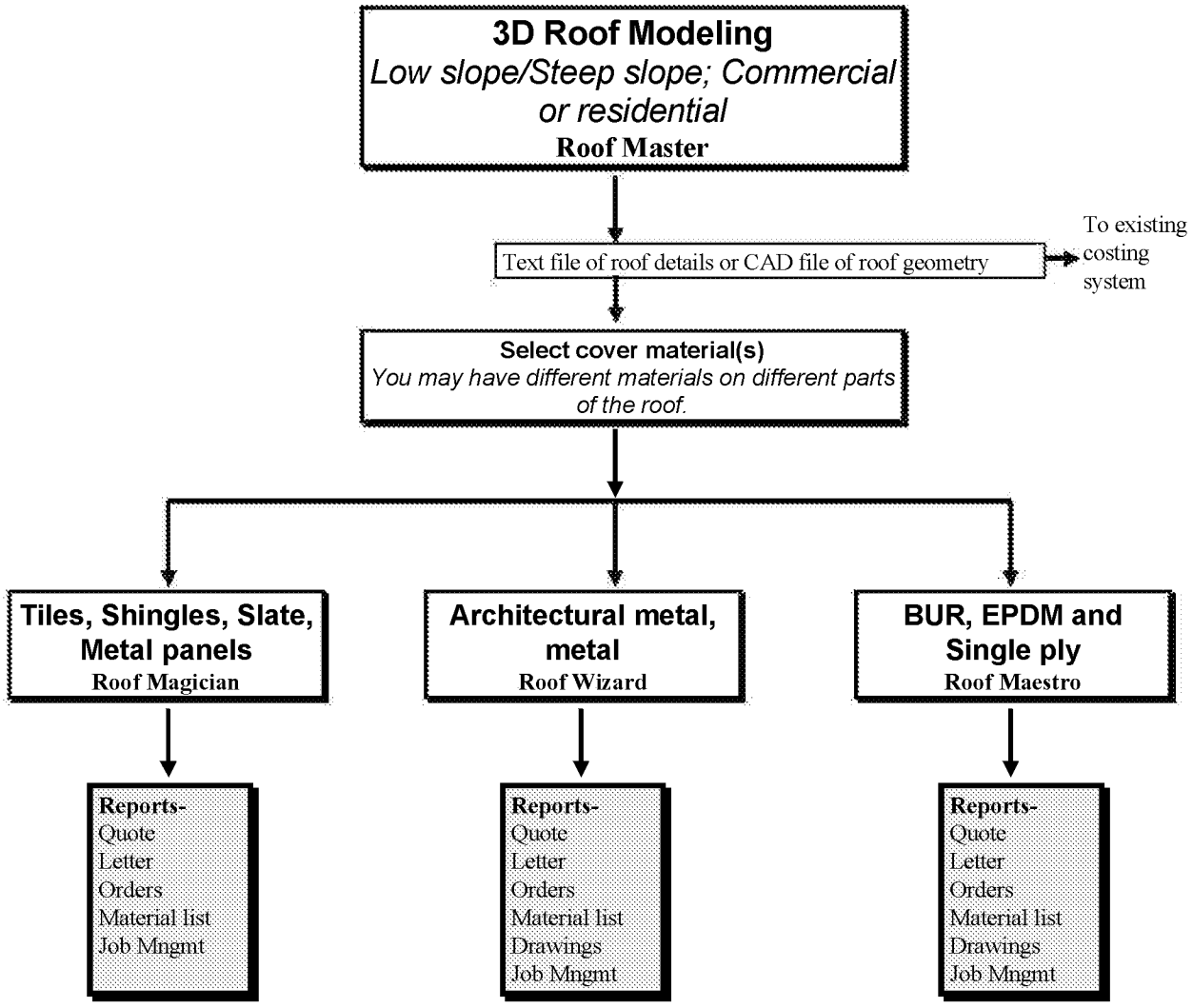
The Sorcerer - Product Guide

	Sorcerer	Roof Magician	Roof Wizard	Roof Maestro	Roof Master
Typical users to benefit	Roof material distributors, manufacturers' reps, roofing contractors, quantity surveyors.	Roof material distributors, manufacturers' reps, roofing contractors, quantity surveyors.	Roof material distributors, manufacturers' reps, roofing contractors, quantity surveyors.	Roof material distributors, manufacturers' reps, roofing contractors, quantity surveyors.	Roof material distributors, manufacturers' reps, roofing contractors, quantity surveyors.
Materials database and report profiles:	tiles, metal tile/panel, shakes, shingles and slate; Standing seam metal, architectural metal;. BUR, EPDM, Single ply.	tiles, metal tile/panel, shakes, shingles and slate.	Standing seam metal, architectural metal.	BUR, EPDM, Single ply.	No material database, roof modeling only.

Each of the products is available as a stand-alone product, providing real benefits to the operator. Sorcerer incorporates the functions and features of all the modules in one totally integrated package.

Sorcerer - Job Flow

The complete solution for professional roof estimating - ***Simple, Fun, Effective.***



Accurate, Professional and Quick Presentation

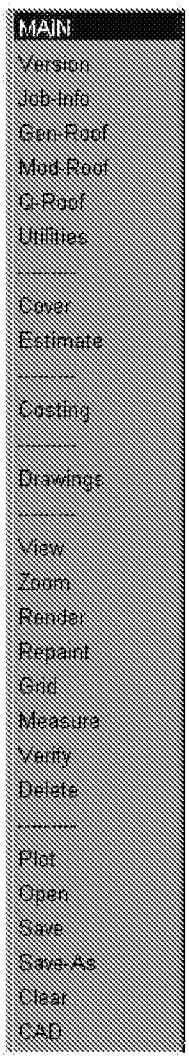
*Roof Wizard, Roof Magician and Roof Maestro modules are available as standalone products and include the roof modeling functions of Roof Master. Sorcerer is a complete system that includes all the functions of each of the modules.

Sorcerer - The Main Menu

The main menu is the list of options that the operator is first presented with when ***Sorcerer*** is started up. As well as the main menu, illustrated on the right, the operator is also presented with an icon menu. This menu replicates the functions of the main menu, presenting the functions in an easy to identify picture, or icon.

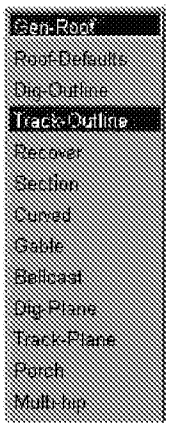
Each menu option, when selected, will bring up the appropriate dialogue modifier box in the centre of the screen. The dialogue box will contain the information required for each stage of the design and estimating process.

The ***Sorcerer*** of programs are truly international with the operator able to set local preferences for units (feet and inches or metric) and language.



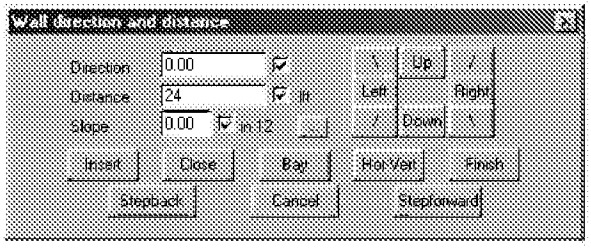
Sorcerer - Roof Generation

The **Gen-Roof** option is used to start the roof design and material estimating process. The whole roof design process is based around the initial creation of hip and valley roof geometry. This basic roof shape is, if required, modified to suit the needs of your client. Comprehensive tools have been developed for the automatic creation of all roof geometry from gables, dutch gables, dormers, atriums, corner gables, multi-hips, verandahs etc.



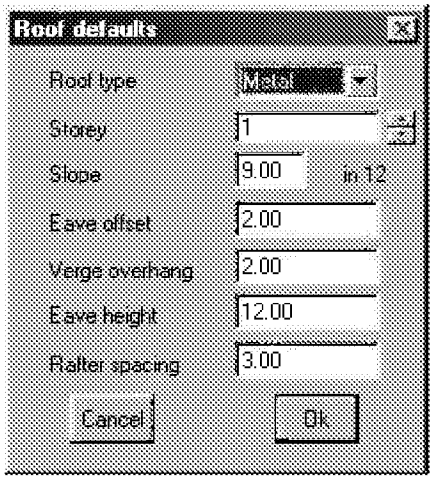
The operator is presented with a number of options for inserting the roof geometry. The first, **Dig-Outline**, allows the operator to "snap" to the extents of the building outline from a plan that has been imported into the system via DXF or DWG format. As many builders and designers these days are using CAD for their drawings, this option is very quick. Alternatively, this method can be used in conjunction with a digitizing tablet.

The more common method is **Track-Outline**. This involves inserting the extents of the house ie. The wall outline, not the roof eave line, using the "wall direction and distance" dialogue box. As each dimension is inserted, the screen will automatically resize to fit the extents of the outline. The direction of the lines, ie. **U**p, **D**own, etc. is selected by clicking on the appropriate button.

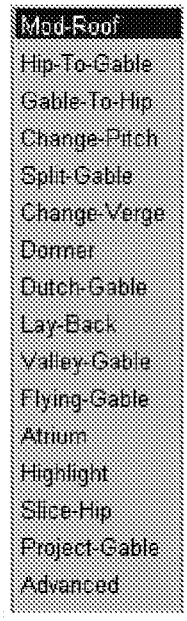


Roof Default Values

The next dialogue box to be displayed prompts the operator for the specifics of the roof construction. The values displayed are common to all the eaves and panels of the roof being defined. Individual alterations to any aspect of the roof can be made at a later date.

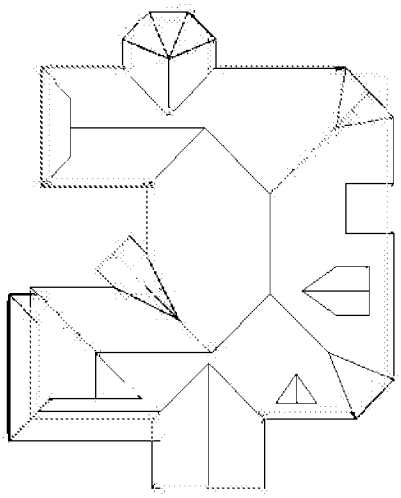


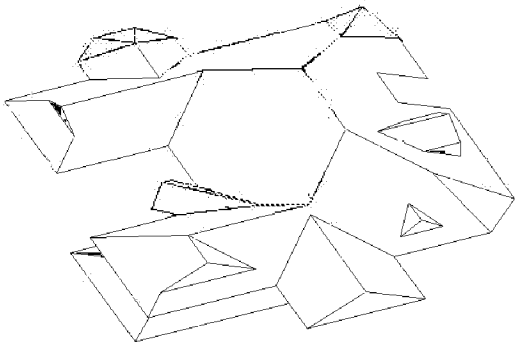
Sorcerer - Modifying the Roof



Once the 3 dimensional roof has been automatically created, a comprehensive selection of advanced modification tools are available, enabling the operator to modify the roof to suit.

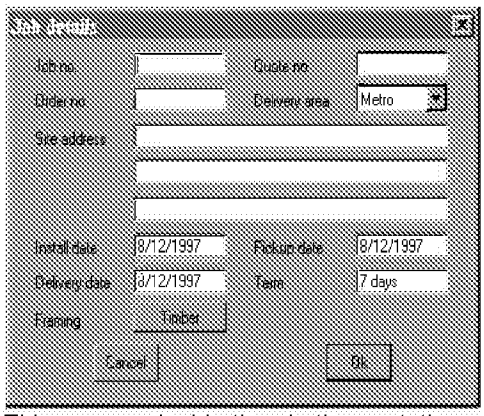
Among the many roof modifications available are: various types of dormers, dutch gables, internal and external corner gables, lay-back gables, atriums, highlight windows and many more. In addition, individual roof panels can have their pitch changed, with the hip, valley and ridge lines automatically updated to reflect any changes made.

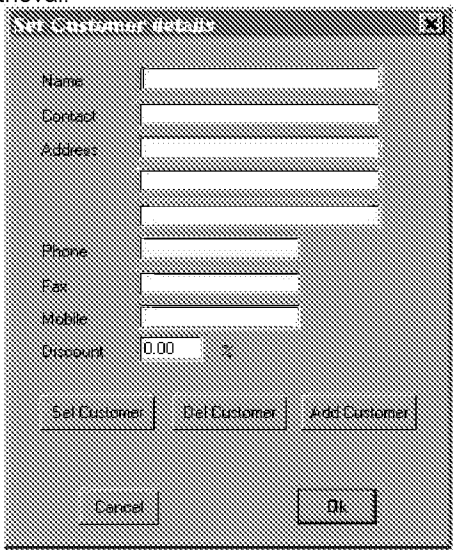




Sorcerer - Job Details

After the roof modifications have been completed, the next step is to enter the details for the specific job. This involves customer, installer, builder, salesman and distributor details, and of course the particulars of the job, such as delivery address and delivery dates, quote numbers etc. These details can be set up or changed at any time, depending on the stage of the job. Any time a new customer, salesman, installer etc. is entered into the system, they are automatically saved into a database for future retrieval.





This saves valuable time in the quotation process. Above are just two examples of the dialogue boxes available.

At this stage the operator with the Roof Master program may export the roof geometry via DXF (a universal CAD exchange format) or export the roof details via a text file format that may be picked up by your favourite spreadsheet or database program. Details such as hip, ridge, valley lengths and roof plane areas. With any of the other Sorcerer modules the operator defines the material that is to be used on the roof. The material type selected will determine which of the modules will be used. Refer to the following product guide which shows which product would be used.

Sorcerer - Material Definitions

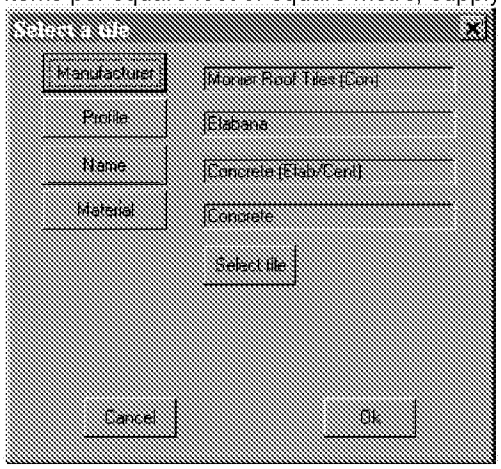
The **Coverage** menu contains the options for defining new manufacturers and material types. Using the **Select a material** dialogue box below as an example, the four fields available - Manufacturer, Profile, Name and Material, bring down further modifier menus to allow the operator to select the desired option. Any number of manufacturers can be set up to appear in this file along with their complete range of materials, profile and colour options. At this point, the operator is also able to automatically or manually dimension the roof and designate any areas that may need to be insulated.

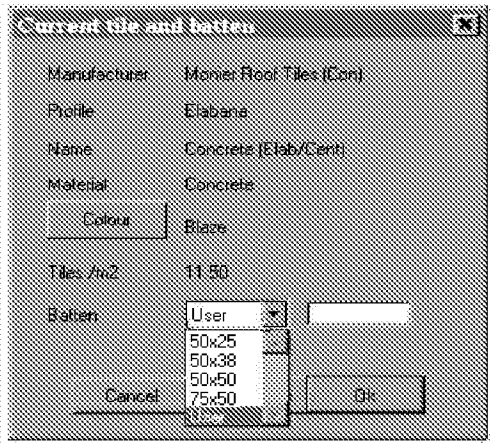
Each roofing material group has it's own product definition file. Roof cover **profiles** may be defined by the user to suit the way a company works and the materials that the company uses.

Sorcerer - Setting up Costing Rates

The software provides for the setting up of all costing rates necessary for producing a complete detailed quote.

These would normally be completed once and revisited from time to time as pay rates change. These include roof costing rates, detailing insulation, fall protection, battens, hip and ridge lengths etc., installers pay rates; and a comprehensive dialogue box allowing the operator to set up the costs for each material type, profile, number of items per square foot or square metre, supply and install pricing, and associated cartage values.

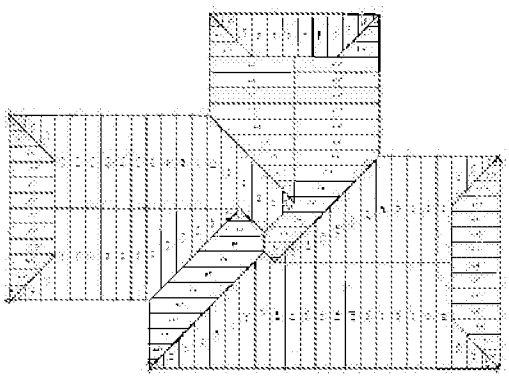


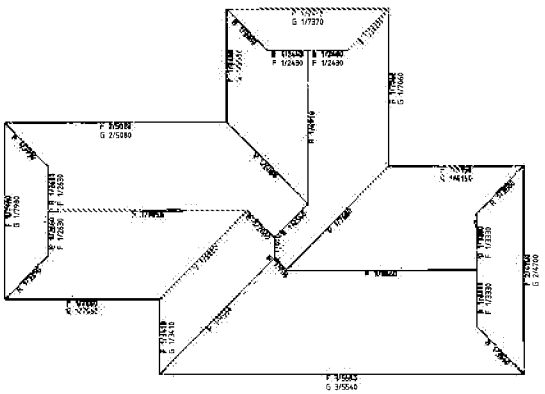


Sorcerer - Tally Materials

The materials are then tallied up so that a cost can be applied. Different materials are tallied differently and indeed some materials may be optimised such that off cut materials may be used elsewhere on the roof - some architectural metal profiles for example. Depending on the materials selected, the appropriate Sorcerer program will use the most effective routine to take off the material quantities.

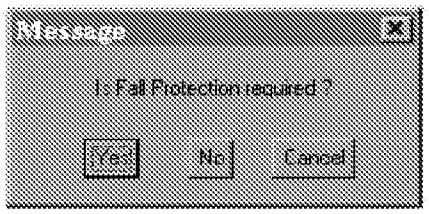
In the process, the roof drawing is annotated with the details of the results of the tallying up. Take the metal roofing as an example: all the cut sheets are shown and the total length of flashings and gutters are automatically dimensioned.





Sorcerer - Cost Summary

Once the roof has been completed, and all of the covering details have been specified, the total job calculations are just a few mouse clicks away. Selecting **Cost-Summary** from the menu, brings up two dialogue boxes dealing with fall protection and installers on-cost percentage.

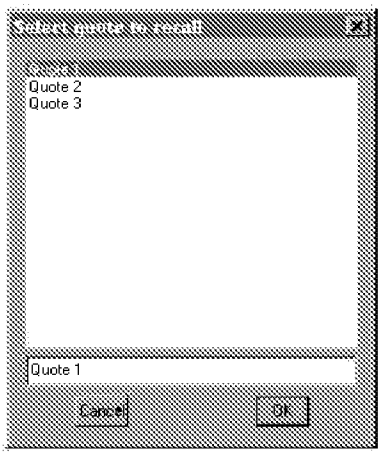


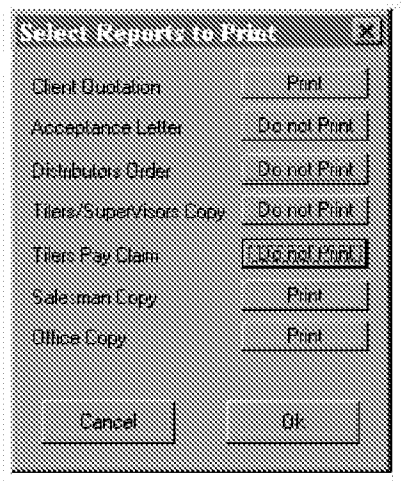
The calculation table is a complete summary of the job being quoted on. A full job cost and quoted price are given, along with the reporting of a profit figure after a sell price has been entered. Any of the values can be changed "on the fly" if necessary, and the total cost of the job re-calculated. When you are happy with the quote, click on **Save** and type in a "quote name". If the client also requires a quote on a different material or profile, simply return to the **Coverage** menu and make the necessary changes. Re-calculate the data and save the new quote under a different name. It's as simple as that.

Sorcerer - Report Printing

After the required quotes have been created, the final step is to produce the necessary reports.
Select **Reports** from the **Main** menu and a dialogue box appears listing the available quotes.

You then have the option of selecting which reports to print, by clicking in the box next to the appropriate report, which toggles between "print" and "do not print".





INSTALLER

Payment Date	Invoice No	TOTAL

appli-cad

832 High St
East Kew Vic 3102
(03) 9859 6622
ACN 052 127 787
Excellent Design

Estimate to Supply and Fix ROOF TILES DATE 1 March 1999 No. Q2314

CLIENT Writer House PHONE 602-383-1854
FAX

ADDRESS 421 Buton Road
Tempe, Arizona 85283-1042

SITE ADDRESS 543 West Bassline Road
Tempe, Arizona 85283-1042

JOB DETAILS		M2 of Tiling	3086.82
Roof Pitch	16.0 in 12	Rafter Centres	3'
Eave O'hang		Batten Sizes	
Verge O'hang		Fixing Date	4 March 1999
Colour	Midnight	Profile	Concrete TBA

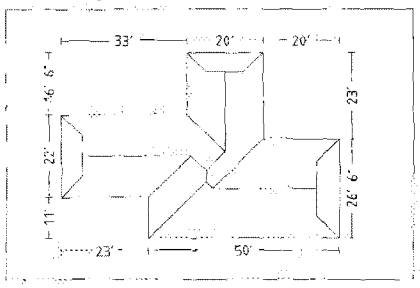
PRICE $ 17000.00

For and on behalf of Appli-Cad

Signed.....

After Hours Phone

SKETCH OF ROOF



SPECIAL NOTES

INSTALLERS PAYMENT		$	ITEM
3086.82	SQ FT TILING		ROOF TILES
3086.82	SQ FT SARKING		RIDGES
96.44	L FT HIPS		SHELLS
56.22	L FT VALLEYS		APEX
80.25	L FT RIDGE		SARKING
46.21	L FT GABLE		BATTE
3'	TRUSS		
	STEEP PITCH		
	2/3 STOREY		
		15772.08	TOTAL

AppliCad

Prepared by Appli-cad
052 127 787

Phone +613 9249 9509
Fax +613 9859 6622

832 High Street
East Kew. 3102

Purchase Order OR4325 - 2

Date 2 March 1999
Job JB2453
Site 543 West Bassline Road
Tempe, Arizona 85283-1042

Please supply the following in good order and condition : Delivery Date 3 March 1999

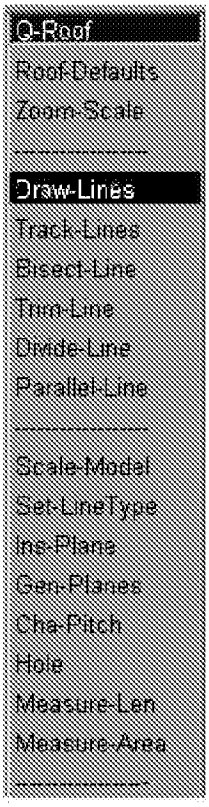
ITEM	QTY	PRICE
Ridge Flashing : Roll top ridge, GALVANISED 1/9050, 1/8660, 1/8560, 1/6910, 2/3560, 2/3310, 2/3060, 1/2560, 1/2060, 2/970	195.54	
Valley Flashing : Valley, GALVANISED 1/7680, 1/6560, 1/6060	66.60	
Fascia : Metal fascia, ZINCALUME 1/7980, 1/7370, 2/7060, 1/6150, 3/5540, 3/5080, 2/4700, 1/3410, 2/3330, 2/2630, 2/2430	318.47	
Gutter : O Gee Gutter, GALVANISED 1/7980, 1/7370, 2/7060, 1/6150, 3/5540, 3/5080, 2/4700, 1/3410	263.42	
BargeBarge, ZINCALUME	56.04	
Purlin : Lightweight, GALVANISED 60/8000	1574.80	
Fasteners : 10x16 Wafer Teks GALVANISED	4.00	
Accessory : Fascia bracket	126.00	
Accessory : Splice plate	4.00	
Accessory : External corner (90)	6.00	
Accessory : Internal corner (90)	4.00	
Accessory : Bracket nails (timber)	1.00	
Accessory : Barge bracket	24.00	
Accessory : Barge corner left	3.00	
Accessory : Barge corner right	3.00	
Accessory : Barge apex cover	3.00	

Page 2 of 6 Signed .....

On this page is an example of one of the many reports that are standard with the software. These forms start as templates that are fully customizable, so you can alter them to look exactly like the ones you currently use. Any information within the system can be extracted and placed on any form in any position. Key text strings tell the software which bit of information needs to be inserted. Using your existing pre-printed stationery or create your own.

Q-Roof

A new development that completes the tool kit for the AppliCad Australia roof estimating is ***Q-Roof***. This is a new process that provides intuitive and intelligent support of various digitisers to input roof geometry quickly and easily. Simple commands guide an operator through the process of creating accurate roof geometry from roof plans. The operator works in plan and automatically generates true roof areas and lengths.



Q-Roof also supports the use of bit map or raster images as an underlay for the digitising process. This allows for the use of scanned building plans as an underlay for digitising, and also the use of building plans down-loaded from the various world wide web bidding services.

Q-Roof includes many smart tools for adjusting the job scale so that nasty old blue-prints may be used and the data re-scaled to represent the actual measurements on the plan.

Roof planes are automatically generated, thus reporting accurately roof areas and material quantities. Once input, all the roof materials and accessories are automatically extracted, orders generated, quote printed and job completed.

With the AppliCad Australia suite of roof estimating software, no job is too big or too small – too complex or too simple.

IN SUMMARY

Sorcerer is without a doubt, the most comprehensive and sophisticated software available for the estimation and quoting of roofing materials.

Sorcerer will increase the accuracy of your quotes to an astounding level, in addition to increasing your productivity. All of which can have a rather prosperous effect on your bottom line.

Sorcerer guarantees to save you valuable time, freeing you up to attend to the more important aspects of your business and eliminate costly quoting errors, helping you to maintain competitiveness in today's tough market.

The modular structure allows you get the exact solution for your particular needs. Regardless of your business priority - commercial, residential, steep slope or low slope - AppliCad Australia has an estimating and job management solution for you at the most competitive price. The advanced functionality will ensure that even with just one bid or quote per day, the software will pay for itself in just a few weeks.

Critical information at a glance!

	Sorcerer	Roof Magician	Roof Wizard	Roof Maestro*	Roof Master
Typical users to benefit	Roof material distributors, manufacturers' reps, roofing contractors, quantity surveyors.	Roof material distributors, manufacturers' reps, roofing contractors. quantity surveyors.	Roof material distributors, manufacturers' reps, roofing contractors. quantity surveyors.	Roof material distributors, manufacturers' reps, roofing contractors, quantity surveyors.	Roof material distributors, manufacturers' reps, roofing contractors, quantity surveyors.
Materials database and report profiles:	tiles, metal tile/panel, shakes, shingles and slate; Standing seam metal, architectural metal;. BUR, EPDM, Single ply	tiles, metal tile/panel, shakes, shingles and slate.	Standing seam metal, architectural metal.	BUR, EPDM, Single ply.	No material database, roof modeling only.

Common Features:

Typical Benefit:

- Easy to learn and fun to use — All your staff can become effective estimators
- Quick and easy roof modeling in 3D — Accurate roof geometry
- Automatic dimensioning — Confidence check on roof plans
- Accurate material and accessory take-off — Nothing missed out in the quotation
- Instant report generation — Fast and easy job management
  Massive time saving
  Eliminates **all** manual paperwork
  Quotation
  Customer acceptance
  Suppliers order
  Installers pay claim
  Office copy and more
- Customizable data files — Set up your material files to suit your business - even add your own descriptions and/or costs.
- User definable report templates — Professional presentation complete with your logo
- Automatic drawing creation — Total information pack for your clients
- Full 3D Cad functions — Additional drafting and reporting may be generated
- Complete quote and roof drawing — Roof drawing can be printed on any document
- Materials and labour costing — Automatic costing in a mouse click - total job control
- Quantify all accessory items — Total job cost - automatically
- Save and recover quotes — Instant re-cost on any job at any time
- GRIM files — Enables any data to be exported, imported or combined

Specific Features:

- Quantify tiles by course or area (Roof Magician) — The most accurate result
- Quantify metal off-cuts (Roof Wizard) — The most efficient use of materials
- Quantity by product profile (Roof Maestro) — The most effective

Sorcerer - feature list

Topic	Feature	Master	Wizard	Magician	Maestro
Roof Modeling	Dig(itize)-Outline	●	●	●	●
	Track-Outline	●	●	●	●
	Recover Outline	●	●	●	●
	Section Roof	●	●	●	●
	Curved Roof	●	●	●	●
	Variable Pitch Gable Roof	●	●	●	●
	Bellcast Roof	●	●	●	●
	Panel Roof	●	●	●	●
	Simple-Verandah	●	●	●	●
	Complex-Verandah	●	●	●	●
	Straight verandah	●	●	●	●
	Bullnose Verandah	●	●	●	●
	Concave Verandah	●	●	●	●
	Convex Verandah	●	●	●	●
	Multiple level roofs	●	●	●	●
Roof Modification	Hip-To-Gable	●	●	●	●
	Gable-To-Hip	●	●	●	●
	Change-Pitch	●	●	●	●
	Split-Gable	●	●	●	●
	Change-Verge	●	●	●	●
	Dormer - Gable	●	●	●	●
	Dormer - Skillion	●	●	●	●
	Dormer - Hip	●	●	●	●
	Dormer - Barrel	●	●	●	●
	Dutch-gable	●	●	●	●
	Lay-Back	●	●	●	●
	Valley-Gable	●	●	●	●
	Flying-Gable	●	●	●	●
	Atrium	●	●	●	●
	Highlight	●	●	●	●
	Slice-Hip	●	●	●	●
	Project-Gable	●	●	●	●
	Advanced Modeling	●	●	●	●
	Advanced - Cutout	●	●	●	●

Q-Roof	Roof Defaults	•	•	•	•
	Zoom Scale	•	•	•	•
	Draw Line	•	•	•	•
	Track Lines	•	•	•	•
	Bisect Lines	•	•	•	•
	Trim Lines	•	•	•	•
	Parallel Lines	•	•	•	•
	Divide Lines	•	•	•	•
	Scale Model	•	•	•	•
	Set Line Type	•	•	•	•
	Insert Plane	•	•	•	•
	Generate Planes	•	•	•	•
	Change Pitch	•	•	•	•
Utilities	Show/hide panels	•	•	•	•
	Show/hide sheets	•	•	•	•
	Set-Display	•	•	•	•
	Dimension Roof	•	•	•	•
	Change Line type		•	•	•
	Change Panel Type		•	•	•
	Tally lengths and areas	•	•	•	•
Job-Info	Set company details		•	•	•
	Set job-details		•	•	•
	Set customer name		•	•	•
	Set Installer name		•	•	•
	Set builder name		•	•	•
	Set salesman name		•	•	•
	Set distributor name		•	•	•
Coverage	Define Tiles/Shingles			•	
	Select Tiles/Shingles			•	
	Select battens			•	
	Select Insulation			•	
Job Management - Costing	Set costing rates			•	
	Set installer pay rates			•	
	Set tile costs			•	
	Display jobcost summary			•	
	Display quote summary			•	
	Quotation defaults			•	
	Jobcost defaults			•	
Job Management - Reports	Quotation			•	
	Acceptance letter			•	

	Distributors order			●	
	Installer copy			●	
	Installer pay claim			●	
	Salesman copy			●	
	Office copy			●	
	Customization			●	
	Flashing Drawing			●	
	Super customization			●	
Coverage	Roofing		●		●
	Individual Panel		●		●
	Verandah		●		●
	Flashings		●		●
	One Flashing		●		●
	Insulation		●		●
	Battens		●		●
	Downpipes		●		●
Job Management -Costing	Set labour rates		●		●
	Display cost summary		●		●
	Set material costs		●		●
	Supply & Install Quote		●		●
	Supply Only Quote		●		●
Job Management -	Quotation		●		●
Drawings and Reports	Installer-pay		●		●
	Cost summary		●		●
	Order forms		●		●
	Roof drawing		●		●
	Sheet layout drawing		●		
	Flashing drawing		●		●
	Batten drawing		●		
	Sheet nesting		●		
Miscellaneous	Changing views		●	●	●
	Zoom and pan		●	●	●
	Render display		●	●	●
	Grid		●	●	●
	Individual measurement		●	●	●
	Custom plotting		●	●	●
	Full CAD capability		●	●	●
	DXF/DWG		●	●	●
	Ascii export (CSV format)	●	●	●	●
	Save to Block	●	●	●	●

Roofing Software

Product Bulletin

Section 1 - Modelling the Roof

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2. Drawing up the Roof

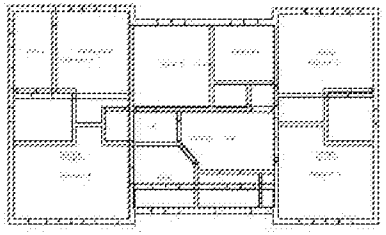
Our software works off the basis of drawing the roof up on the screen, using a series of easy-to-use menus. Providing you enter the dimensions for the perimeter of the roof accurately, and give the correct angle or slope, then the roof generated on the screen should resemble the roof in question. This gives the operator a great deal of confidence in the outputs from our software as you are able to verify that the numbers you entered will result in the same roof that you are bidding for. "If it looks like your roof then it will be your roof!"

Because our software sits on top of a very powerful 3 dimensional CAD package, we can utilize various tools to enable the drawing of the roof and checking the result, before submitting to a bid. In the following sections, we have demonstrated a number of methods of achieving this.

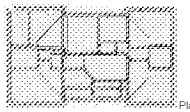
3. Importing Roof or Building outlines from another CAD system

More often than not, these days the roof plans you are working from have been drawn up using a CAD system, and then printed out to hard copy, resulting in thick piles of printed drawings which then need to be scaled off by hand or used in conjunct on with a tablet or digitiser. Whilst our software can support the use of a digitiser, it is far easier to use other methods to get the roof outline in. The most obvious one is to import the CAD drawing of the roof plans direct from your customer.

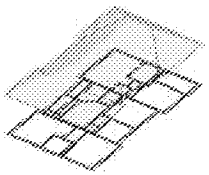
CAD drawings can be saved in various different file formats, and our software supports most of these, but the most common form is the .dxf format (drawing exchange format). The real benefit of this is that there is no need to re-scale the plan, and the software will be able to 'snap' to the nearest points, thus eliminating a lot of inaccuracies of measuring. The plan below is an imported CAD drawing.



By using the command Digitise Outline we can then move the cursor to the extremities of the wall outline, by 'snapping' to those points, and after entering the pitch or slope of the roof and the eave offset from the wall, the roof is generated automatically, resulting in an accurate and fast method of working out the areas and lengths.

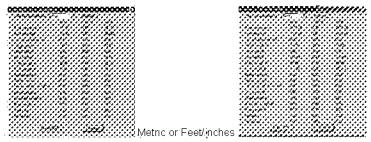


Plan or Iso view.



At this point you could then continue and apply the material to the roof to achieve the take-off quantities.

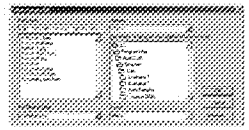
Software is available in Metric or Imperial



Metric or Feet/Inches

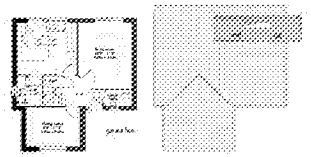
4. Importing Roof or Building outlines from a scanned image or bitmap

We recognize that you may not have the luxury of obtaining the CAD file for the drawing in question, but you may be able to scan the roof plan, using a flatbed scanner. This type of hardware is available at a relatively low cost at most computer supply outlets. Our software can also allow the import of such scanned images directly into the program to eliminate the need to scale the dimensions off the drawing. Note this feature can also be used if you can obtain the image of the floorplan via the internet. There are a number of web sites that allow you to download the image file for the floorplan you wish to quote on, and our software would allow that downloaded file to import directly into the program.



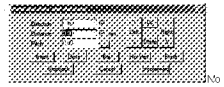
Using the imported scanned image, we can then digitize around the outline, as with the previous example, although this time we need to re-scale the roof once it is generated. You will only need to enter the true measurement from one reference line and the software will then scale the whole roof proportionally.

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6. Using our Track-Outline Command

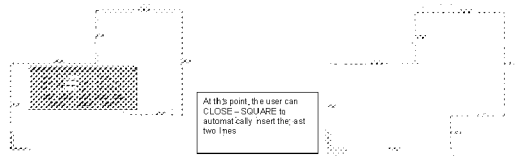
Having mentioned the previous two methods of getting the roof or wall outline into the software, the most common method used is our Track Outline feature. This command allows the user to very simply enter the direction and dimension of each wall to produce the wall outline. We have built in a number of features to simplify this process, such as the insertion of Bay windows, or lines at unusual angles. We also invented the idea of "Closing" the outline with a right angle to allow the user to double check that the whole outline squares up, and the outline is of the correct dimensions.



No matter how complex the outline

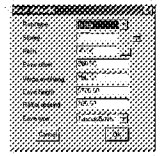


From this outline, the user simply enters the pitch (or slope), the eave offset and the eave height.

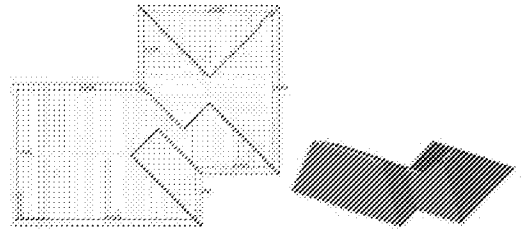


Key Benefit: Important means of double checking the dimensions entered...

At this stage, the software will generate a hipped roof, based on the outline, but we can change any side to become a gable end. We can also change the eave or gable offset from any line and the outline to any shape.



The resulting roof will now be generated and allow the user to view the roof in 3 dimensions to verify that it resembles the roof on the plan

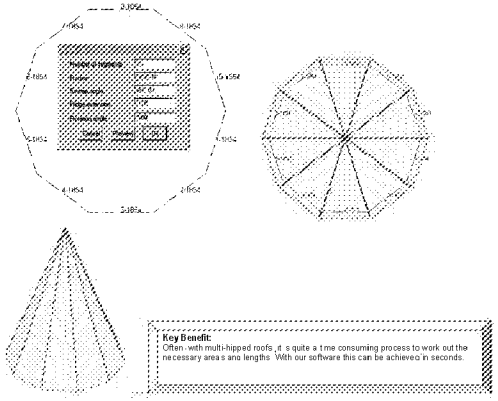


Key Benefit:
The areas and lengths have already been calculated at this point. You can use these values to double check the outputs from manual processes and give you a greater level of confidence in the software.

6. Drawing up Multi-Hip Roofs

There are often times when you need to generate part of a roof to have multiple hips, such as a 'church spire". We have built in a feature that allows you to generate this type of roof simply and easily.

2222



Key Benefit
Often with multi-hipped roofs, it is quite a time consuming process to work out the necessary areas and lengths. With our software this can be achieved in seconds.

To go to the next section - **Section 2 - Modifying the Roof** - Click Here

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Sorcerer

Advanced Software for Roof Modeling and Estimating

Reference Guide

Version 3 8th September 1999

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Introduction

About the Reference Guide

The purpose of this document is to provide a listing of all the commands in ***Sorcerer***. Some operational advice has been provided but it should be read in conjunction with the ***Sorcerer*** Learning Guide, which describes a more hands on approach to ***Sorcerer***.

About *Sorcerer*

Australian software developers have a world-wide reputation for innovative and unique products. AppliCad is an application developer based in the Australian southern city of Melbourne, and we have proven once again that this is indeed the case. With the release of the software package for roof design and estimation called ***Sorcerer***, we have hit new heights with functionality, ease of use and outstanding value for money.

The ***Sorcerer*** software is integrated with a 3D CAD (Computer Aided Design) modeling system and takes full advantage of the powerful 3D capabilities. The ***Sorcerer*** software provides metal roofing estimators with a complete suite of tools for roofing design, estimating and presentation. The basic principle of ***Sorcerer*** is based upon a simple overview of the design process - ***Sorcerer*** works the way you do.

While no previous computer aided design (CAD) experience is considered necessary, a certain level of understanding of metal roofing and building is expected. ***Sorcerer*** takes the chore out of roof design and estimating. The estimator gains immediate benefits in producing accurate designs and precise quotations for a wide range of roof designs. A complete set of detailed forms is produced so that everyone involved in the process has a record of the proposed transaction.

At AppliCad, our role is to create the best products we can. Your feedback helps us get better at meeting your needs. We know you set high standards, and so do we. Let us know how we can improve our service to you.

System Requirements

To function correctly, the program requires the following

- **Graphics card** - minimum resolution 800x600, 256 colours (do not select a larger color set eg 24 bit).
- **Three button mouse**, Logitech is recommended, and setup to run with three buttons. (We use the middle button for online help and point snap.)
- About **50 Mbytes free** on your hard disk. The program doesn't actually take up all this space, the electronic documentation does.
- **Pentium processor** - the faster the better
- **Windows '95 or Windows '98, Windows NT 4 or 3.51** - Note: ***Sorcerer*** will basically run on any computer that will run Windows '95+. However, running it and using it effectively are two different things. Windows uses as much RAM as you can give it and the ***Sorcerer*** will thrive with more RAM rather than less; **32Mbytes** should be considered minimum under Win95/NT.

Installing *Sorcerer*

This installation CD includes everything you need to get ***Sorcerer*** running.

To install ***Sorcerer***

- Insert the CD-ROM, and connect to it with Windows Explorer or File Manager.
- Double click SETUP in the root directory of the CDROM and follow the on screen instructions (saying *next* or *continue* when prompted without changing anything), a directory or folder called ***Sorcerer*** is created under the c:\Program Files\Applicad folder, ***Sorcerer*** software is installed to the ***Sorcerer*** folder.
- The operator may choose to install the software into a different directory or folder, in any case

the ***Sorcerer*** is installed under the specified folder.

If you didn't install the AcroBat reader during the installation process, you can at a later date by changing to the C:\Program Files\Applicad\Sorcerer\Manuals directory and double click *ar32e30.exe*.

This will install the Adobe Acrobat Reader to your system. You may also like to associate the PDF file extension to the acrobat reader.

The manuals are contained in the C:\Program\Files\Applicad\Sorcerer\Manuals folder.

To view the ***Sorcerer Reference Guide*** (which in fact is a copy of the manual you are reading now) start Acrobat, select *file|open*, and select sorcrg3.PDF in the
C:\Program Files\Applicad\Sorcerer\Manuals folder.

The file, *MODELV44.PDF* is the complete documentation on the 3D drafting and modeling component and *GSTRTV44.PDF* is the 'getting started' guide for the Modeler. These manuals are recommended reading for very experienced operators, seeking to get more from the modeling and drawing part of the software.

An understanding of the basic principals of the 3D drafting environment is a great benefit and will ensure that you get the most from the ***Sorcerer*** System.

It is possible to learn and effectively use ***Sorcerer*** without formal training in a very reasonable time. However, the new user *must* read these notes if they are to get started in the best possible time.

Have fun, and please contact us immediately if you are having any difficulty at all.

Disclaimer

Feedback from users is encouraged and welcomed, please feel free to advise us of your needs at any time.

As we are constantly reviewing the functions of our software in response to user requests, you may notice minor variations between the manual and the software we have shipped to you. Please let us know if you discover any inaccuracies.
It is our stated policy that we strive for the best software tools that the technology allows us to develop. We reserve the right to make changes for future releases at any time without prior notice.

The Process

The foundation of the ***Sorcerer*** software is based upon the creation of accurate roof geometry - ie the roof geometry must first be correctly modeled in 3D space. It is from this definition of the roof that the roof areas and quantities are extracted. Clearly, if the roof modeling is not accurate, the whole process is compromised.

We have devised a simple three stage process to ensure an easy outcome-

- ***Define the roof geometry,***
- ***Select the roof covering material and***
- ***Cost the roof.***

It is a simple matter then of printing the necessary reports.

To assist the operator in the roof modeling process, we have included some very sophisticated but simple, single mouse 'click' operations that allow a roof to be constructed from basic principles.

The usual starting point for a roof using this system is a basic hip and valley roof. From this just about any roof may be modeled by adding all the architectural features including dormers, atriums, gables, verandahs etc. (Specialised roof shapes such as a barrel vaulted roof, or simple flat or skillion roof is handled separately.)

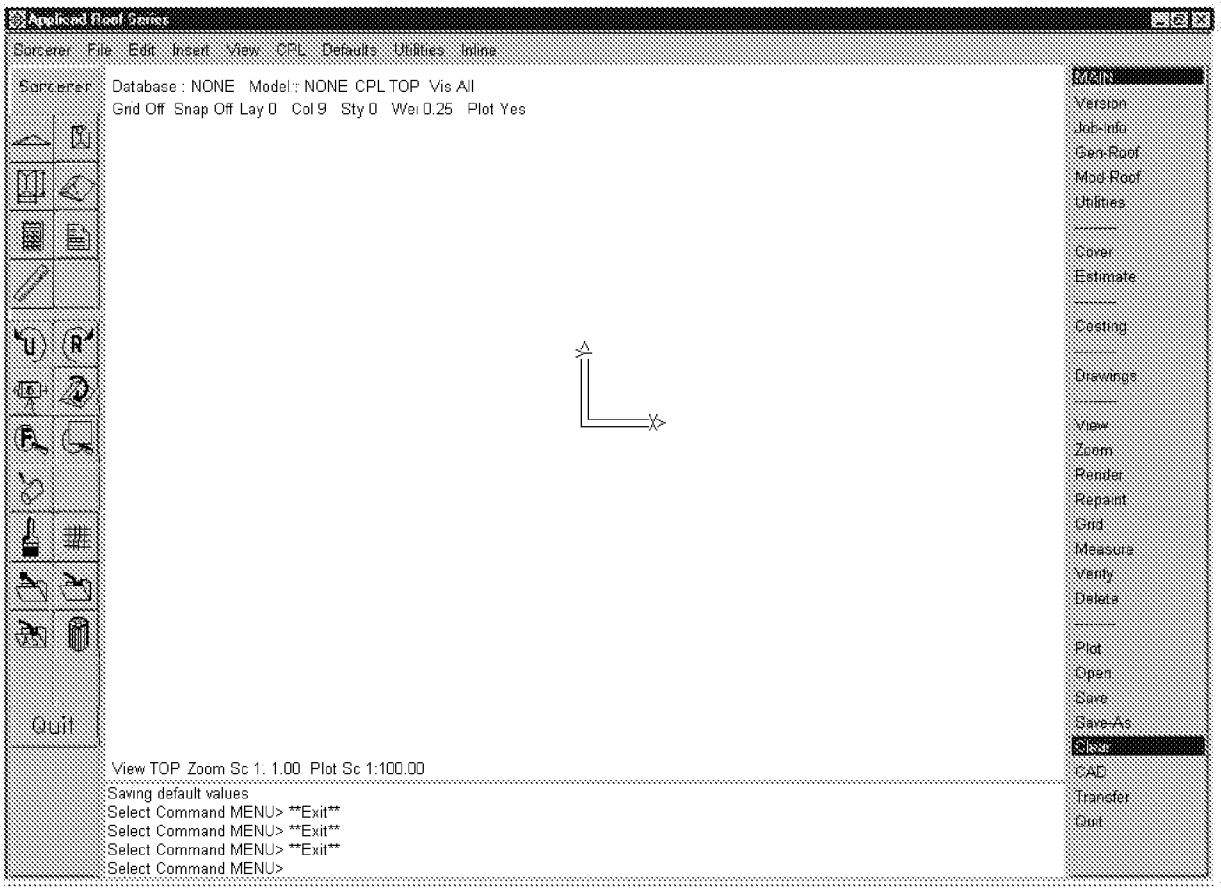
After the roof geometry has been created, the roof coverage must be defined. This is done by selecting the material to be used from a list of materials. Other fixtures and fittings that are required are automatically accounted for by the program. You may also select the type of flashings you want to use.

By way of estimating the roof, a block layout drawing is produced, which is an automated process based on the most commonly used manual estimating method. This process then produces a complete material list for the roof.

After creating the material list, costing of the job is automatic, providing you with the ability to modify the quote prior to printing the necessary reports.

The Interface

The interface is the screen as it is presented to you after you have started ***Sorcerer***. A great deal of information is right before your eyes and it can be a bit overwhelming at first.
Refer to the illustration of the ***Sorcerer*** screen below:

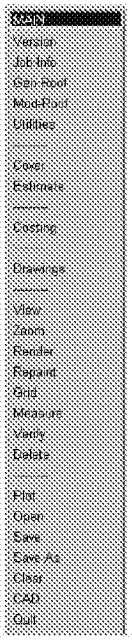


At the top of the screen we have the **Pulldown menu**, different commands are accessible from here and they are also available in lower levels of the text menu.



To select these commands, simply click on the item and a drop down menu is displayed. Repeat this until you find the command you are after. This menu is present to streamline the side menu. The menu items and commands can be found in the text file *pulldown.pdm*, The file may be edited to add often used commands to make them more accessible.

Menus and User Prompts



Notice that you have a list of functions on the right hand side of the screen, this we call the **Text Menu**. To select a command from the text menu, simply click the command with the left mouse button. Then, you would either get another submenu or be prompted for some input. You can access online documentation, by clicking the appropriate command with the middle mouse button.



On the left we have the **Icon** menu, many of the text menu commands are replicated here for your convenience. Clicking an icon with the left mouse button, will activate the command. To find out what menu command is called, click the icon with the middle mouse button. The command line for that icon is displayed at the bottom of the screen.

At the bottom on the screen there is the **Prompt area**. All instructions and responses to commands are displayed here. If you are not sure what to do, look here first, it tells you what to do.

```
Select Command MENU> **Exit**
Select Command MENU> **Exit**
Select Command MENU>
```

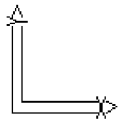
Clicking the Caddsman icon up at the top left corner of the window, you not only get the standard windows commands of Restoring, Minimizing, Closing etc, but also the ability to copy a rectangular area of the window into the windows clipboard. To do this, select Copy Bitmap and digitize a rectangular area on the screen. You can then use the paste commands of the target application such as WORD or EXCEL, to paste this picture. You may also capture the entire screen, press <Alt> Print Screen keys together.

> For a better understanding of these processes consult your Windows documentation.

The application runs in a typical Windows window, thus letting you resize it, close it etc.

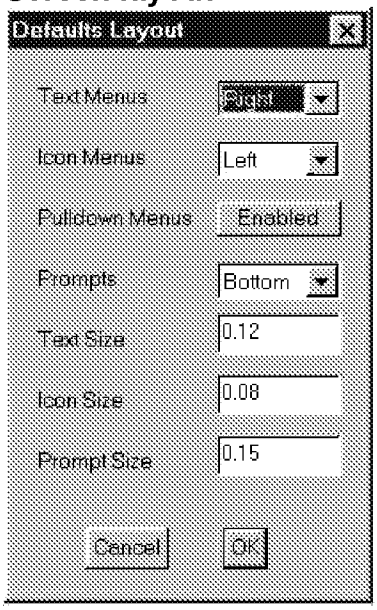
At the top and bottom of the graphics display area, there are the **Status lines** which describe to you such things as the current database and model name, zoom and plot scales etc.

```
Database : NONE   Model : NONE  CPL TOP  Vis All                View TOP  Zoom Sc 1: 0.91  Plot Sc 1:100.00
Grid Off  Snap Off
```



In the center of the graphics area is the **Construction Plane (CPL)** icon that shows you the orientation of the coordinate system. The +x direction is initially to the right and the +y direction is up the screen. You can alter the orientation as you require using the **Drawing CPL** commands

Screen layout



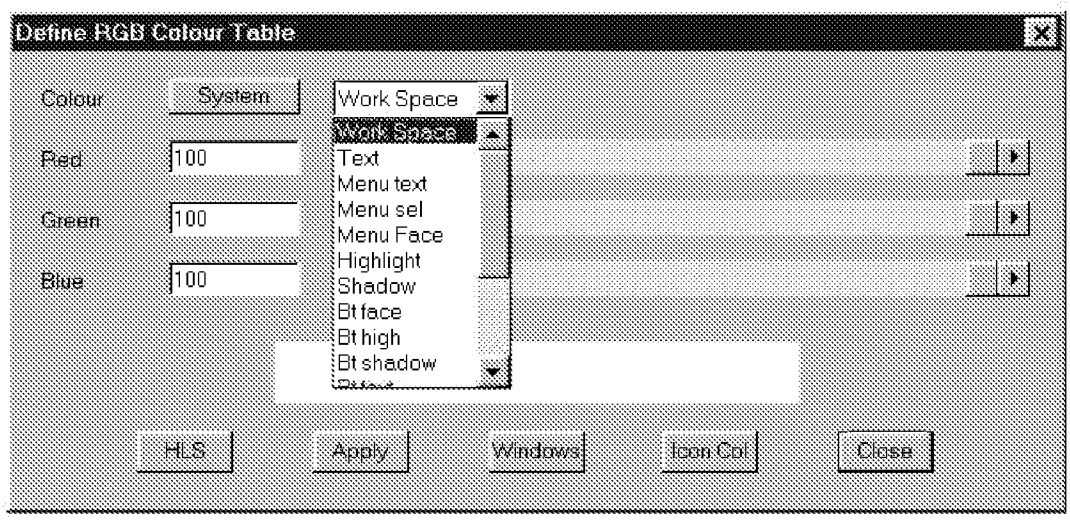
You can change the screen layout with the **Drawing Defaults Layout** command.

Here you can mask the appearance of the side menus as well as adjusting their size.

To make these changes permanent, select **File Save-values** from the pulldown menu.

Screen Colours

You can alter the screen colours using Drawing Defaults Col-Tab which lets you change the color for individual components.



Clicking the color **System** button, changes to **User**, which allows you to change each color used by the modeling process for entity colours ie lines, circles etc. Otherwise, the system colours are displayed in the combo box.

To make these changes permanent, select **File Save-values** from the pulldown menu.

Mouse usage

As you progress, you will notice that nearly all input is via the mouse. After comprehensive testing we have determined this to be the most effective method of input when used in conjunction with the clever dialog boxes.

You should be aware of several conventions when using your mouse. We recommend a three button mouse such as Logitech, but if your computer does not have one, the middle button function may be replicated by holding down the shift key on the keyboard and using left mouse button.

The Logitech mouse may have the Logitech Control Centre software installed which has the capability of changing the mouse button

assignments. Check that the middle mouse is actually 'middle mouse' button, and right mouse button is 'Alternate select'.

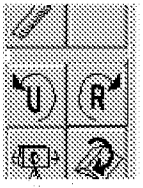
Mouse conventions

The **left mouse** button is used to select a command or digitise a point on the screen. The **right mouse** button is used to cancel, finish or abort a command. The **middle button** is used to snap to an existing point or line end point. It may also be used to bring up the "inline" commands and online help.

Dialog Boxes

In writing the software, comprehensive use is made of dialog boxes. They may be information boxes or input boxes. The input boxes have default values already in them. In this way we have reduced the amount of information you must enter repeatedly. Also, in the training phase, if you're not sure about what will happen, go ahead and do it anyway, accept the values displayed in the dialog box and test the result. The dialog boxes work in the same way as any windows dialog box.

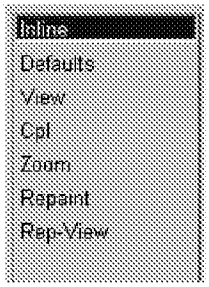
Undo and Redo



You have unlimited ***undo*** and ***redo*** commands to fix up your testing - if the command didn't give you the result you were expecting simply select ***undo*** from the icon menu**,** and try the function again.

The Inline Menu

The inline menu is a context sensitive menu which you can display by pressing the <F2> key at any time, or clicking the middle mouse button at the edge of the screen. There are three versions of the inline menu.



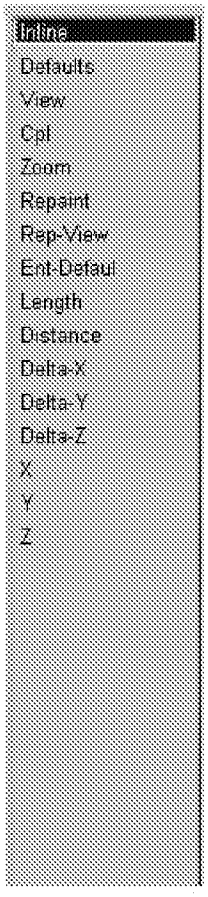
This version is displayed if the current prompt in the prompt area at the bottom of the screen is to 'select a command'.



This version is displayed when you are prompted to locate a position.

This version is displayed when you are prompted to enter a number.

If you click into a dialog box field which requires a numeric input, then pressing <F2> will get this version.



Coordinate Input

When drawing a roof outline, you are presented with a method based on you not knowing much about coordinates. However, from time to time you may have to enter point coordinates.

You will recall that when you are prompted to locate a point you can either, click anywhere on the screen with the left mouse button or snap to an existing point with the middle button.

You can enter a coordinate via the keyboard also.

You enter a coordinate at the `LOC>` prompt by entering an x and y pair.
For example, to enter a coordinate of (3000,5000), you would enter

```
LOC> 3000 5000
```

here, the z value is assumed to be 0. If you want the z to be 2700 (eave height), then you would enter

```
LOC> 3000 5000 2700
```

These coordinates are with respect to the current CPL (**c**onstruction **pl**ane) orientation. You will recall, that the CPL defines the x and y directions (the z is automatically defined to be normal or sqare to these 2 ie out of the screen).

Therefore, by knowing the coordinates of the corners of the roof, you can draw it by coordinates.

You can also enter an **i**ncremental coordinate. That is, instead of using absolute coordinates, you can enter a coordinate relative to the previous point.

For example, you can enter 2 points (3000,5000) and (6000,9000) as

```
LOC> 3000 5000
LOC> 6000 9000
```

or

```
LOC> 3000 5000
LOC> i 3000 4000
```

Here, the **i** modifier, tells the system to move incrementally from the previous point.

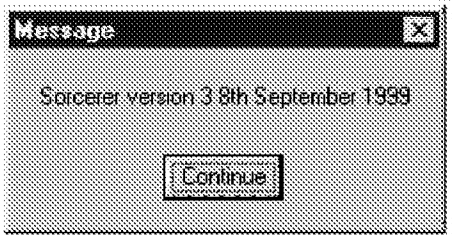
> Remember : to find out a lot more about the interface, consult the Caddsman Modeler Getting Started Manual. This is the file *GSTRTV44.PDF* in the Manuals subdirectory and may be viewed using the Acrobat Reader.

The Main Menu

This section describes the commands on the main menu, also referred to as the **Text Menu.**

Version

This command simply reports the specific version of ***Sorcerer*** you are using.

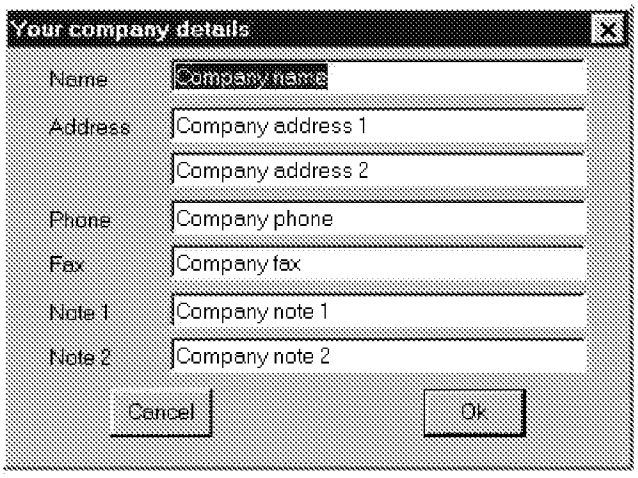


Job-Info

This command displays a sub-menu which lets you define job related information such as customer, site address etc.

Company

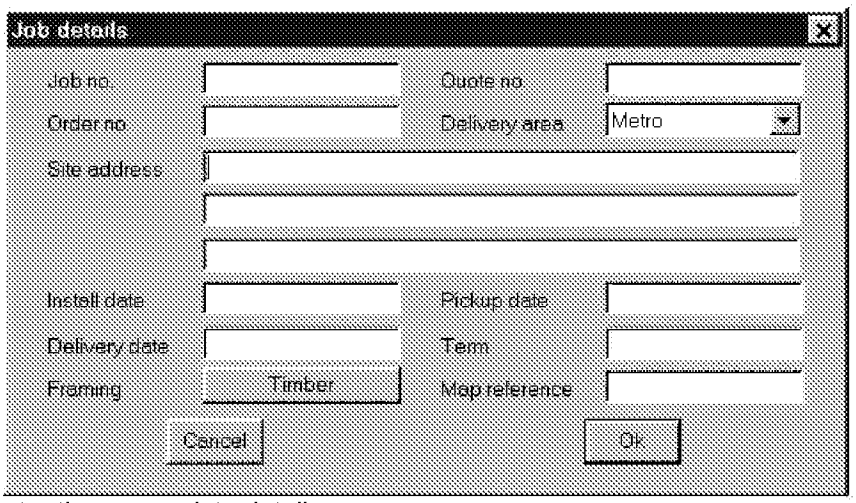
This command allows you to set your individual company information.



When you click **Ok**, the company details are saved.

Job-details

This command display the Job-details dialog box, which lets you set the job specific information.



Here you can enter the appropriate details.

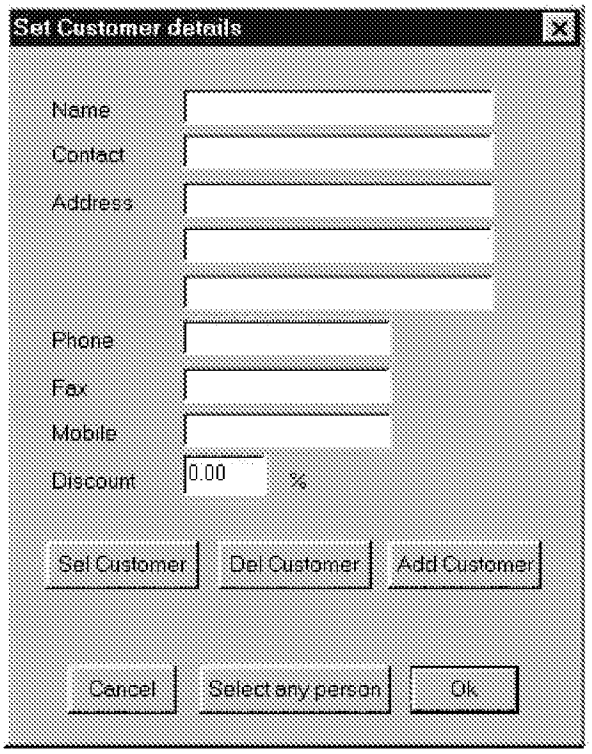
Job No	The job number for the job
Quote No	The quote number.
Order no	The order number.
Delivery area	A drop down list of up to 10 items describing different delivery areas you may have. You may edit the text file *areas.dat* to change the actual area names.
Site address	The site address, up to 3 lines
Start date	The date to start the job
Pickup date	The date the material is picked up
Delivery date	The date the material is to be delivered to site.
Terms	The payment terms
Framing	Toggles from Timber to Steel
Map reference	A street directory grid reference for the site.

When you click **Ok**, the values are saved for this job.

The values you enter may be automatically inserted onto the reports and drawings you create for the job. If you don't fill out those fields, then the information won't be printed.

Customer, Installer, Builder, Salesman and Distributor

These commands let you set the particular person against each of these roles. When you select the particular role, the Select person details dialog box is displayed.



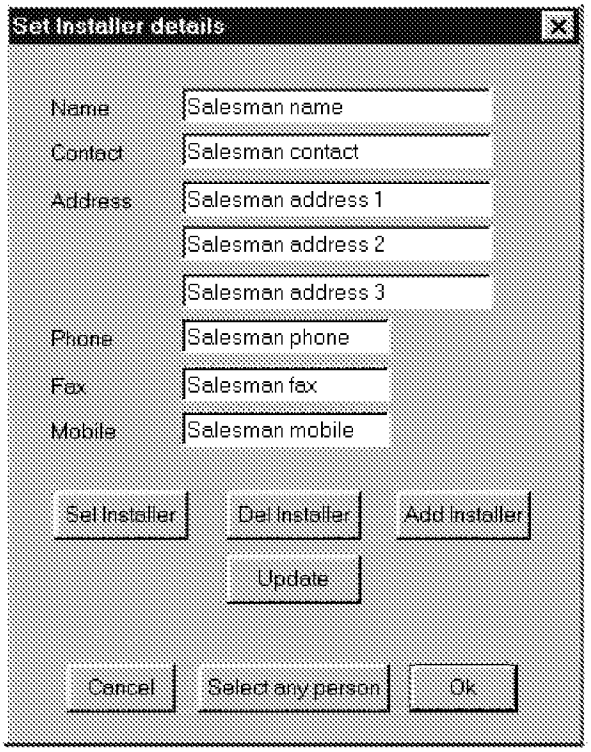
Here you can set or select the person you want. In this case, we are looking at the Customer role, but the same goes for all roles.

Name	The name of the person or company
Contact	The contact name
Address	The 3 line address
Phone	The phone number
Fax	The fax number
Mobile	The mobile phone number
Discount	The discount used for this customer. This is only present for the Customer. This is the default value used when you do a job costing.

You can enter values as you wish and click **Ok** to save that person.

You can also select a new customer from the list of customers by clicking **Sel Customer**.
You can delete the current customer by clicking **Del Customer**,
You can add a new customer to the person database by clicking **Add Customer**.
If you want to select from the entire person database, click **Select any person**

If you want to update an existing person, first select the person. An Update button then appears on the dialog box. Make your changes, then click **Update** which then updates that person back into the database.



Gen-Roof

These commands are the primary commands you use to generate a roof. You can generate a fully hipped roof, a single plane or even a barrel vaulted roof. The method you choose is totally dependent on the roof you have to model.

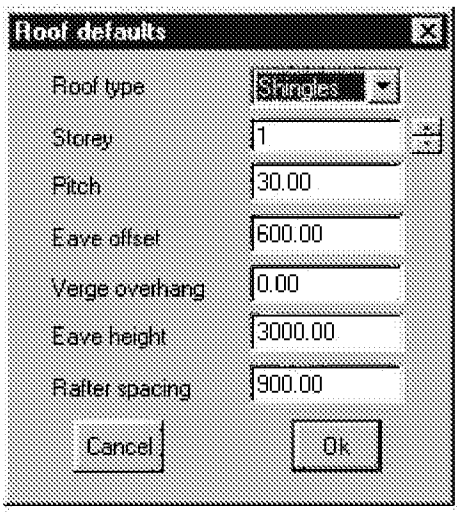
If the roof is predominately hip and valley, then you would use the **Dig-Outline** or **Track-Outline** commands. If it is a flat roof, then you would use **Dig-Plane** or **Track-Plane** which allow you to draw around a single plane.

There are other more specific commands to model a gable, barrel, section and bellcast roof as well.

Dig-Outline	You use this command to create a fully hipped roof by digitising an existing roof outline on a tablet or after importing the outline as a DXF file.
Track-Outline	You use this command to create a fully hipped roof by entering the direction and length of each side of the roof outline
Recover	You use this command to recover the previous outline if you happened to make a mistake when generating the outline the first time.
Section	You use this command to generate an extruded roof by drawing a cross section of the roof and entering the length of the roof
Curved	You use this command to create a barrel vaulted roof
Gable	You use this command to create a simple gable roof
Bellcast	You use this command to create a bellcast roof
Dig-Plane	You use this command to create a single roof plane by digitising the outline
Track-Plane	You use this command to create a single roof plane by tracking the outline
Verandah	You use this command to create a verandah or porch.

Roof-Defaults

This commands sets the defaults for the next roof insertion.

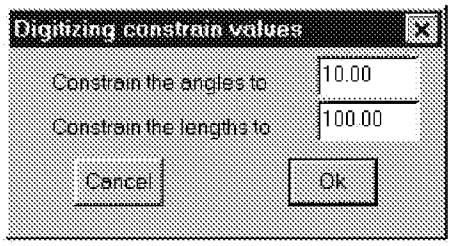


Dig-Outline

If you want to generate a fully hipped roof by digitising the outline of the roof then you would use **Dig-Outline**. To use this command successfully, you need to

- know the (x,y) coordinates of the outline of the roof
  or
- digitise the roof plan on a digitising tablet and apply a scale factor
  or
- digitise on a snapping grid (the Grid command)

When you select the command, the Digitizing constrain values dialog box is displayed.



Here you can set constrain values for angles and lengths. The constrain value is with respect to the horizontal direction.
The effect of constraining angles is to make "near" horizontal and vertical lines to be actually horizontal and vertical. So, if you set the constrain angle to 10 degrees, then the resultant line segments will be recalculated such that its angle with the horizontal will be an even multiple of 10 degrees.
The effect of constraining lengths is to make a line say, 997.334 mm long, to be 1000 mm long automatically. If you set the constrain length to 10mm, then the resultant line length will be rounded to the nearest 10mm.
This approach also affects, **Gen-Roof Dig-Plane**, **Mod-Roof Advanced Hole** and **Mod-Roof Advanced Cutout.**

You can disable constrain by entering 0 in either or both fields.

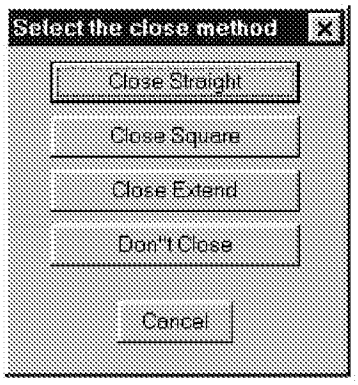
When you select the command, cross hairs appear on the screen and you are prompted to digitise the first corner of the wall. After clicking the first corner, you then continue to locate successive corners around the outline.

To snap to an existing point, use the middle mouse button

As you proceed, dashed construction lines are drawn between the points, as well as a wall number and the length of the wall. These construction lines only exist as a temporary guide to the wall definition.

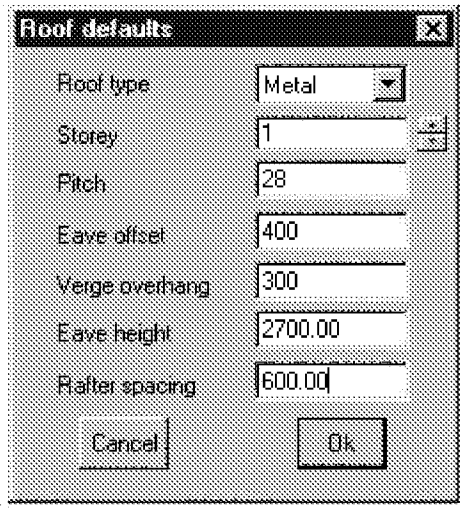
When you have finished locating the corners, click the right hand mouse button. This displays the Select the close method dialog which helps you select the type of close method you want.

The close methods are:



Close Straight	This simply joins the last point to the first point
Close Square	This creates another corner
Close Extend	This extends the last direction to intersect the first wall.
Don't Close	If there is a gap between the last and first points, then it does the same as the Close Straight method
Cancel	If you click Cancel, the process is terminated.

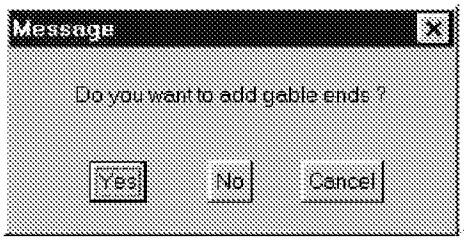
After you click a suitable close method, you then see the Roof defaults dialog. This allows to you set the following parameters about the roof.



Roof type	Here you choose he basic material on this roof. It is one of Tiles, Shingle, Shakes, Metal and Low-Slope.
Storey	You can set the storey of the roof as 1, 2 etc. This makes it easier to separate the roofs making up each storey on screen. Also, various labor rates for estimating a roof can vary from one storey to the next.
Pitch	This is the pitch of the roof
Eave Offset	This is the eave overhang past the wall outline you have digitised. If you actually digitised the fascia for the roof, then set the eave offset to 0 (zero)
Verge overhang	This is the same as the eave offset but relates to the overhang of a gable end past the wall line.
Eave height	This is the height of the eave. You may ignore putting in a real value here if you wish, as it is only used for reporting and measuring downpipe lengths. It is important however for multiple level structures such as double storey or split level to correctly display the different eave heights.
Rafter spacing	This is the rafter spacing which serves no purpose other than for reporting.
Cancel	This cancels the roof generation
Ok	You can proceed with the roof generation

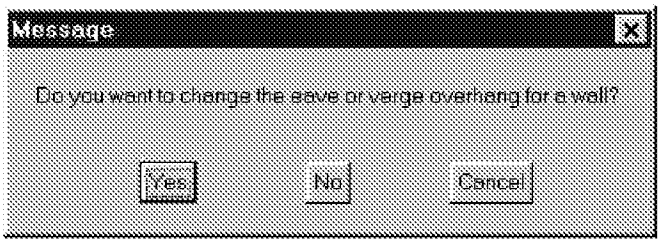
After you click **Ok**, the wall lines are drawn and you are then prompted to add gable ends.

If you click **Yes** to this option, you then select one or more wall lines where you want a gable (rather



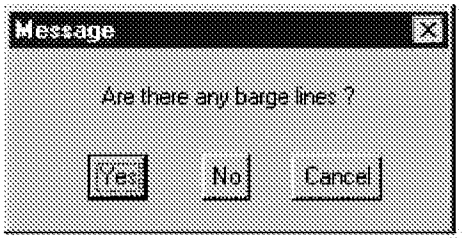
than a hip end). Click the right mouse hand button to finish selecting gable wall lines.

After finishing selecting the gable lines, you are then prompted to alter the eave or verge overhang for a specific wall.
If you click **Yes**, you then select a wall line and enter a new eave overhang value. Click the right



mouse button to finish.

After finishing selecting eave lines to change, you are prompted to select barge (rake) lines if there are any.



Barge lines define a change in eave height in a single roof plane. To make geometric sense, there cannot be a single barge line, but a combination of barge lines which collectively compensate for a change in eave height.

After you have finished selecting gable lines, new eave offsets and barge lines, the roof is drawn showing all the fascias, hips, ridges, valleys and barges. On each plane, a plane is created as well. This simply links its lines together to form a single roof plane.
It is this plane which is used to calculate the area of the roof as well as other geometric properties.

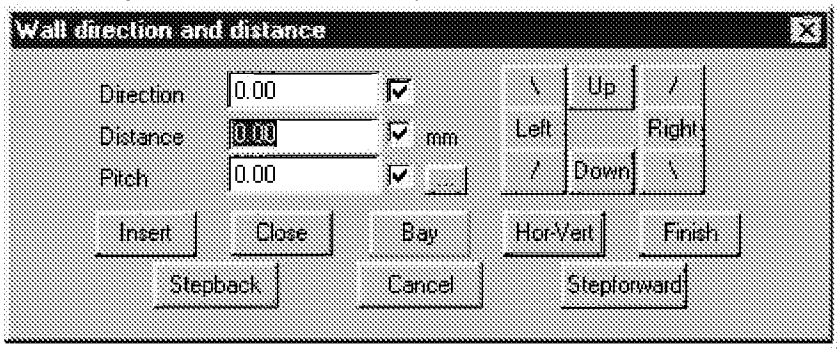
To visualize the plane, you can select **Utilities Show-Planes** which draws each roof plane with a hatch. To turn off the hatching, select **Utilities Hide-Planes**. When the roof plane is drawn without a hatch, a small tick mark is drawn in one of the corners of the plane. You would then select this tick mark if you want to select that roof plane.
You cannot delete a roofline without first deleting the roof plane the line is attached to. Also note that most roof lines are attached to 2 roof planes.

Track-Outline

If you want to generate a fully hipped roof by using the dimensions of the outline of the walls or roof, then you would use **Track-Outline**. To use this command successfully, you need to know from the plan -

- the direction and length of each wall segment
  and
- to decide if you are tracking the wall outline or the fascia outline.

When you select the Track-Outline command, cross hairs appear on the screen and you are prompted to digitise the first corner of the wall. (It is not important where you start on screen as the outline is automatically scaled to fit the screen).



After clicking the first corner, the Wall Direction and Distance dialog box is displayed.

This dialog has been designed to allow you to quickly and efficiently enter the outline of the wall or roof based on a variety of inputs.

The dialog box shows two fields labeled as Direction and Distance. The direction is a cardinal bearing starting at 0° up the screen, clockwise through 180° down the screen, and back up to 0/360°. The distance simply relates to the length of the wall.

The accelerator buttons on the right hand side, are predefined directions with the following values

\ 315°	**Up** 0°	/ 45°
Left 270°		**Right** 90°
/ 225°	**Down** 180°	\ 135°

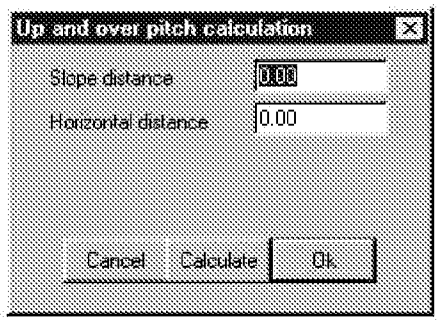
You can also use the letters u, d, l and r in the distance field to quickly get up, down, left and right directions. For example, you can enter r 5000 in the distance field to get a wall defined as right 5000.

You simply click the appropriate accelerator button, enter the distance and a new wall segment is drawn on the screen.
You can enter a new wall by selecting the Enter key or clicking the **Insert** button.

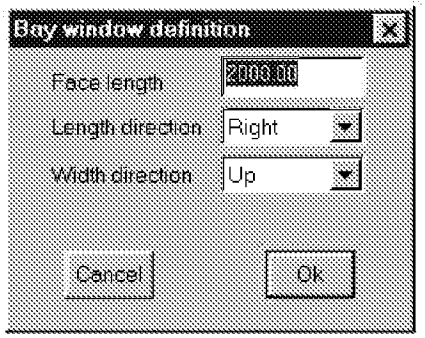
If you make a mistake with a value, click the **Stepback** button.
You can undo a **Stepback** operation by clicking the **Stepforward** button. You can **Stepforward** as many segments you stepped back.
To close an outline, click the **Close** button. This will then display the Close dialog box from which you select a close method. You are then returned to the Wall Direction and Distance dialog box.
To finish entering an outline, click **Finish**.

When you click Finish, the Roof defaults dialog box is displayed. Please refer to the Dig-Outline command for an explanation.

The distance you enter is also modified by the Pitch field. If this is zero, then the distance is horizontal, otherwise the pitch is used to reduce the distance to the horizontal. If you do not explicitly know the pitch but have “up and over “ measurements, you can click the ‘...’ button to the right of the pitch field to calculate the pitch.

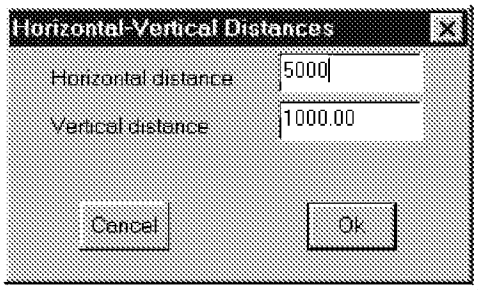


If you have a bay window, click the **Bay** button, This displays the Bay window definition dialog box which helps you draw a symmetric bay window.



Face Length This is the length of each face of the bay window
Length direction This is one of up, down, left or right
Width direction This is one of up , down, or left, right
The bay window is drawn when you click **Ok**.

If you only know the horizontal and vertical dimensions of a wall (rather than its direction and length), you can click **Hor-Vert**. The Horizontal-Vertical Distances dialog box is then displayed.



Horizontal distance The horizontal distance (offset) of the wall
Vertical distance The vertical distance (offset) of the wall.
That wall segment is drawn when you click **Ok**.

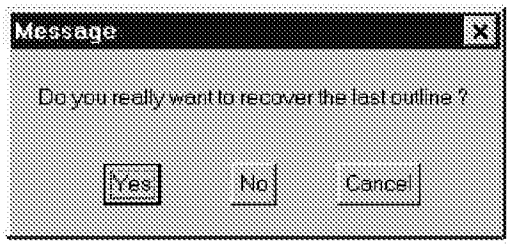
Recover

The **Gen-Roof Recover** command allows you to recover an outline and change it. If you are in a cleared model, then the most recent outline is returned. If you are in a model in which you have already entered one or more outlines, you can recover one of those. (Note that an outline is only complete after the hips have been created).

Each time you run **Dig-Outline** and **Track-Outline**, the outline you entered is saved into a file called *lastjob.dat* as well as in the current model. Then, when you select **Recover**, that outline is loaded and ready for you to edit.

If there is more than one outline in the model, each one is cycled through for you to select one.

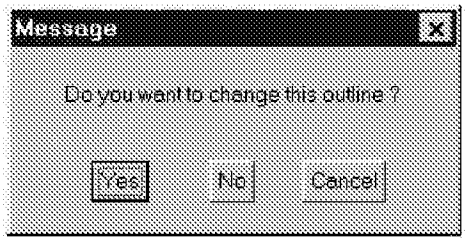
When you select the outline you want, you are first prompted to confirm that you do want to recover the last outline.



If you click **Yes**, the outline is loaded and an attempt is made to delete the relevant planes and linework making up the roof defined by that outline.

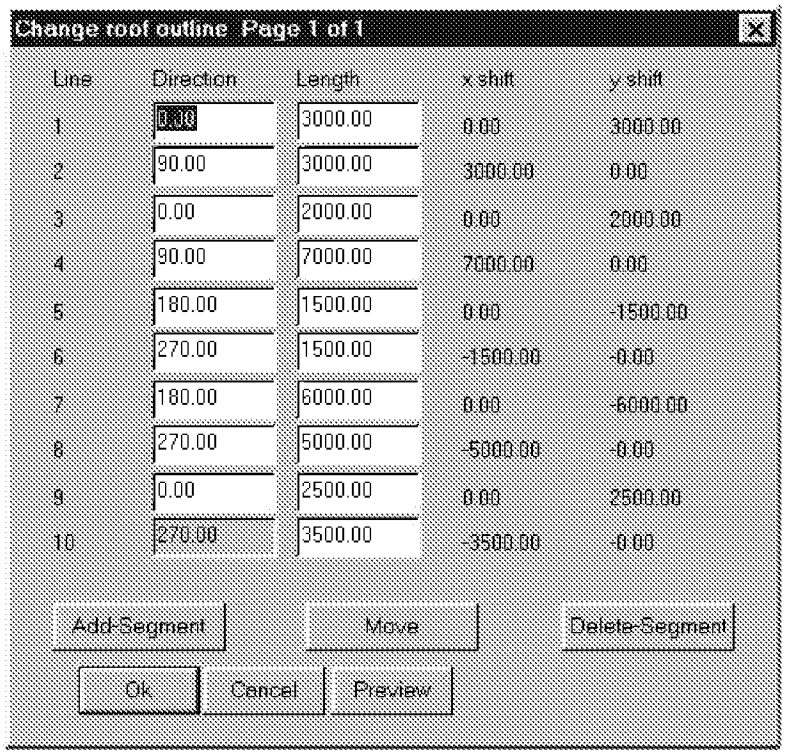
If you click **No** or **Cancel**, then no change takes place.

You are then asked if you want to change the outline.



If you click **No**, then the program continues much like **Dig-Outline**

If you click **Yes**, the direction and distance of each side are displayed in the Change Roof Outline dialog box. You can then change a direction or distance as you see fit. You can also see the x and y displacement for each segment.



Add-Segment	Clicking this button lets you add a new wall segment after a specified segment. You then enter the bearing and distance of the new wall segment.
Delete-Segment	This button lets you delete a specified wall segment
Move	This button prompts you to enter a shift in both horizontal and vertical directions which then moves the entire outline by that amount.
Preview	Draws the outline in temporary graphics so you can preview any changes before accepting the outline
Ok	The command carries on with constructing the roof
Cancel	Any changes you have made are discarded and the process stops.

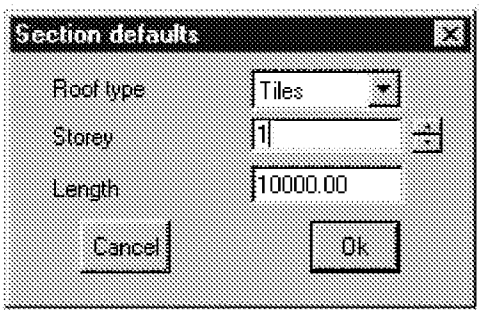
Note : Other changes you have made to the roof (such as the Mod-Roof Commands) are not maintained.

Section

If you have a roof that is an extrusion of a cross-section, then you would use the **Section** command. To use this command successfully, you first need to draw up the section in Top view using the line drawing commands under **Mod-Roof Advanced**, or under the **Drawing** command.

After drawing the section, select the **Section** command. Then you are prompted to select the first line defining the roof section. Then you are prompted to select the next lines one after the other. Keep in mind that each successive line must be joined to the previous line.

When you have finished, click the right mouse button. Then the Section defaults dialog box is displayed allowing you to enter parameters defining this roof.



Roof type Here you choose he basic material on this roof. It is one of Tiles, Shingle, Shakes Metal and Low-Slope.

Storey You can set the storey of the roof as 1, 2 etc. This makes it easier to separate the roofs making up each storey on screen. Also, various labor rates for estimating a roof can vary from one storey to the next.

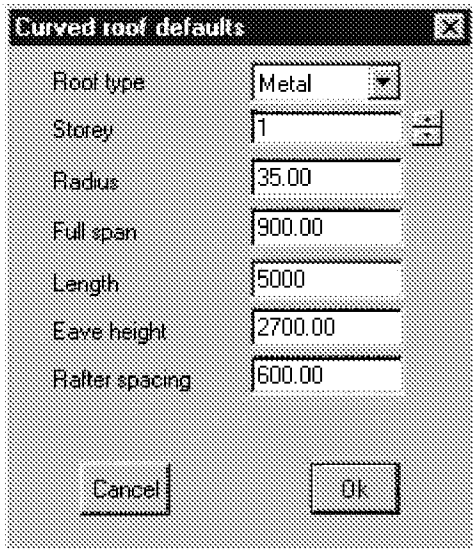
Length The length of the roof. This is the amount the section will be extruded.

When you click **Ok**, the roof is constructed.

Curved

If you have a symmetrical curved (sprung or barrel vaulted) roof, then you would use the **Curved** command to draw it.

When you click this command, you are prompted to locate the top center of the curved roof. Then you locate the direction of the roof. When you have done that, the Curved roof defaults dialog box is displayed, allowing you to set parameters for this roof.



Roof type Here you choose the basic material on this roof. It is one of Tiles, Shingle, Shakes, Metal and Low-Slope.

Storey You can set the storey of the roof as 1, 2 etc. This makes it easier to separate the roofs making up each storey on screen. Also, various labor rates for estimating a roof can vary from one storey to the next.

Radius This is the radius of the curved roof

Full span This is the span (width) of the curved roof

Length This is the length of the roof. The default length is the distance you have already digitised

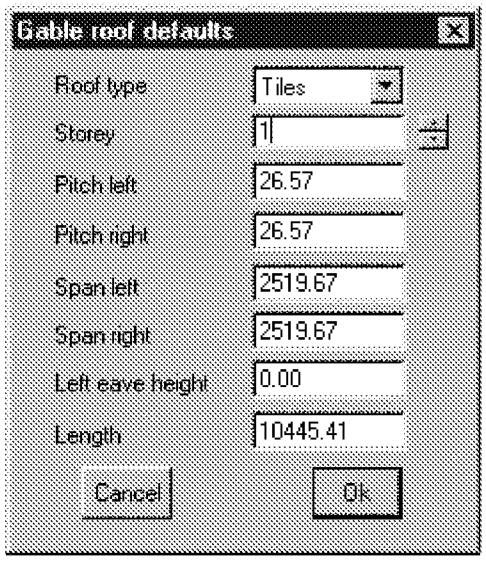
Eave height This is the height of the eaves

Rafter spacing	This is the rafter spacing which serves no purpose other than for reporting.
Cancel	This cancels the roof generation
Ok	You can proceed with the roof generation

When you click **Ok**, the curved roof is drawn.

Gable

If you have a symmetrical gable roof, then you would use the **Gable** command to draw it. Also, if you have a gable projecting into an exis ting roof, then you would first draw the gable here, then use **Mod-Roof Project-Gable** to project this gable into the main roof.
When you click this command, you are prompted to locate the start of the ridge for the gable. Then you locate the direction of the roof. When you have done that, the Gable roof defaults dialog box is displayed, allowing you to set parameters for this roof.



Roof type	Here you choose the basic material on this roof. It is one of Tiles, Shingle, Shake, Metal and Low-Slope.
Storey	You can set the storey of the roof as 1, 2 etc. This makes it easier to separate the roofs making up each storey on screen. Also, various labor rates for estimating a roof can vary from one storey to the next.
Pitch left	This is the pitch of the left hand plane
Pitch right	This is the pitch of the right hand plane
Span left	This is the span (width) from the ridge to the left hand fascia
Span right	This is the span (width) from the ridge to the right hand fascia
Left eave height	This is the height of the left hand fascia
Length	This is the length of the roof. The default length is the distance you have already digitised
Cancel	This cancels the roof generation
Ok	You can proceed with the roof generation

When you click **Ok**, the gable roof is drawn.

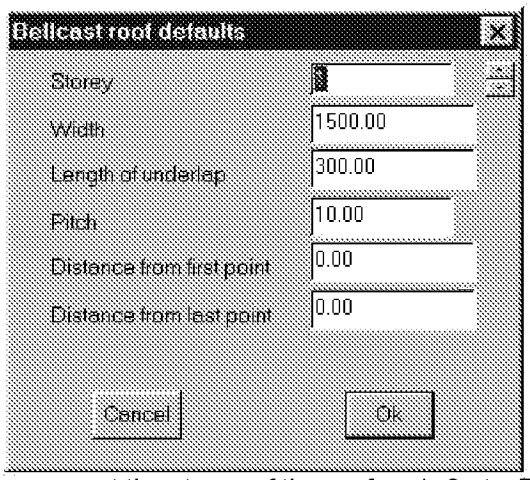
Note: the height of the right hand fascia is a calculated value.

Bellcast

To use this command successfully, you first need to model the main roof using the above commands. Also, you need to have defined the alignment of where the bellcast roof will be attached. To do that, you would use the roof modification commands under **Mod-Roof**.

Assuming you have modeled the roof and cut back the main roof to the bellcast attachment alignment, you then select the **Bellcast** command.

You are then prompted to select successive lines which are the bellcast attachment lines on the main roof. When you have finished, click the right mouse button. Then, you digitise a point which is the side of this new roof. After that, the Bellcast roof default dialog box is displayed. Here you can set the parameters for the roof.



Storey You can set the storey of the roof as 1, 2 etc. This makes it easier to separate the roofs making up each storey on screen. Also, various labor rates for estimating a roof can vary from one storey to the next.

Width This is the width of the bellcast part of the roof.

Length of underlap This is the amount the top edge of the bellcast roof projects past the alignment line

Pitch This is the pitch of the bellcast roof.

Distance from first point This is the distance the bellcast roof will start from the first point of the first alignment line

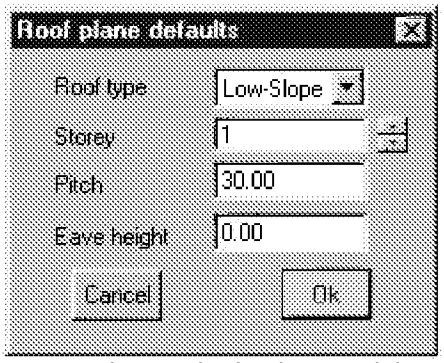
Distance from last point This is the distance the bellcast roof will start from the last point of the last alignment line

You can extend the bellcast roof past the first and last points on the eave by typing a negative distance.

Dig-Plane

You would use this command to simply digitize around a shape to create a single plane. The input method is exactly the same as **Dig-Outline** except the shape you draw is taken to be a single plane rather than a roof outline.

After you complete the outline, by clicking the right mouse button . After you complete the outline, by clicking the right hand mouse button, the Plane defaults dialog is displayed.



Roof type Here you choose the basic material on this roof. It is one of Tiles, Shingle,

	Shake, Metal and Low-Slope.
Storey	This is the storey for the new plane
Pitch	This is the pitch of the new plane
Eave height	This is the height of the eave of the new plane.

After you click **Ok**, you then select the line which the plane is pitched about

After all that, the plane is drawn and the boundary lines are automatically assigned their line type. After the outline of the plane is drawn, you need to select the line which the plane is pitched about.

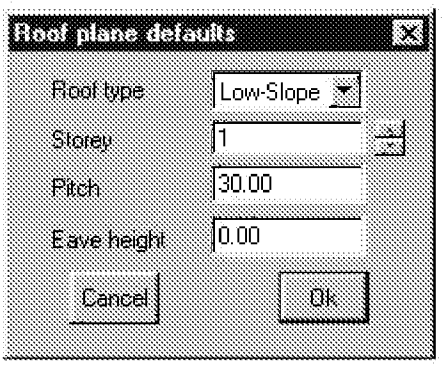
After all that, the plane is drawn and the boundary lines are assigned their line type.

> When the roof plane is drawn without a hatch, a small tick mark is drawn in one of the corners of the plane. You would then select this tick mark if you need to select that roof plane.

Track-Plane

You would use this command to track around a shape to create a single plane. The input method is exactly the same as **Track-Outline** except the shape you draw is taken to be a single plane rather than a roof outline.

After you complete the outline, by selecting an appropriate close method, the Plane defaults dialog is displayed.



Roof type	Here you choose the basic material on this roof. It is one of Tiles, Shingle, Shake, Metal and Low-Slope.
Storey	This is the storey for the new plane
Pitch	This is the pitch of the new plane
Eave height	This is the height of the eave of the new plane.

After you click **Ok**, you then select the line which the plane is pitched about

After all that, the plane is drawn and the boundary lines are automatically assigned their line type.

> When the roof plane is drawn without a hatch, a small tick mark is drawn in one of the corners of the plane. You would then select this tick mark if you want to select that roof plane to do something to.
>
> If you have digitized or tracked a plane which butts another plane, you need to check if there are two lines defining the flashing type on the overlapping edge. If there is, then you could use the **Utilities Cha-Line-type** command to change the line type if the drawn lines are not what you want.

Verandah

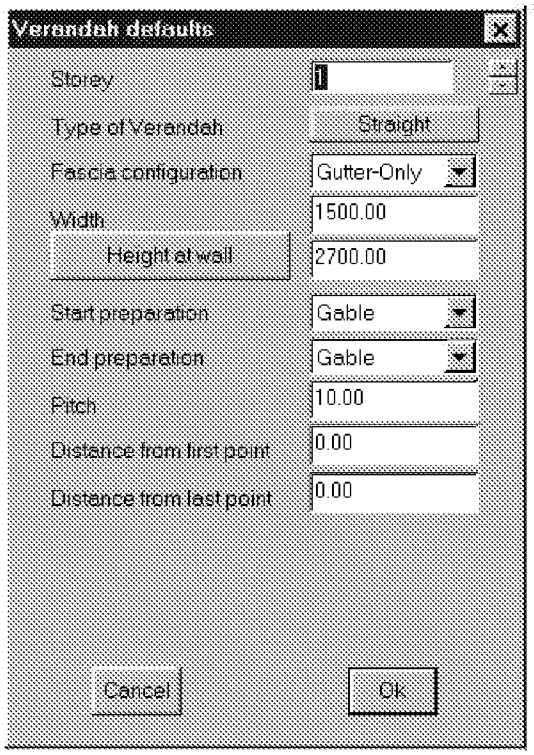
This roof method lets you draw a straight or bullnose verandah quickly and efficiently. Verandahs are subdivided into Simple ones and Complex ones. A simple verandah is a verandah which has the same width all the way around and its fascia is parallel to the attaching wall. A complex verandah is one where the width may vary from one side to the next and the fascia not necessarily following the attached wall.

Even though a complex verandah can also draw a simple verandah, the simple verandah is easier to use and constitutes the majority of verandahs.

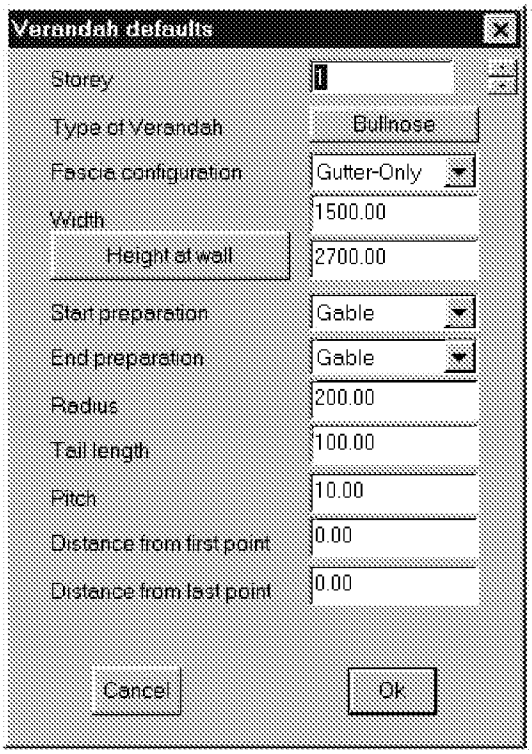
Simple

When you click the **Simple** command, you then select successive lines which define the wall alignment of the verandah. These lines need not be connected but they must intersect. When you have finished selecting the wall lines, click the right mouse button.

Now, the first line remains highlighted for you to decide which side the verandah should be. After clicking a point, anywhere on the side you want the verandah, the Verandah defaults dialog is displayed. Here you set the parameters for the verandah.



Simple straight verandah



Simple bullnose verandah

Storey — You can set the storey of the verandah as 1, 2 etc. This makes it easier to separate the roofs making up each storey on screen. Also, various labor rates for estimating a roof can vary from one storey to the next.

Type of verandah — This button toggles between Straight and Bullnose (See below)

Width — This is the width of the verandah

Height at wall — This button toggles between *Height at wall* and *Height of gutter*. The value you then enter alters the overall height of the verandah accordingly.

Start preparation — The start preparation can be one of Hip, Gable and Butts-Wall. Hip will draw a hip end on the verandah. Gable, makes the start of the verandah a gable end with barge flashing. Butts-wall makes the start of the verandah a gable end with apron flashing.

End preparation — The start preparation can be one of Hip, Gable and Butts-Wall. Hip will draw a hip end on the verandah. Gable, makes the start of the

verandah a gable end with barge flashing. Butts-wall makes the start of the verandah a gable end with apron flashing.

Pitch This is the pitch of the verandah

Distance from first point This is the distance the verandah will start from the first point of the first alignment line. For your convenience, this point is flashing while the dialog box is displayed.

Distance from last point This is the distance the verandah will start from the last point of he last alignment line

If you select a Bullnose verandah to draw, the dialog box has these extra parameters

Radius This is the radius of the bend in the bullnose.

Tail length This is the vertical straight bit of the bullnose hanging down the fascia

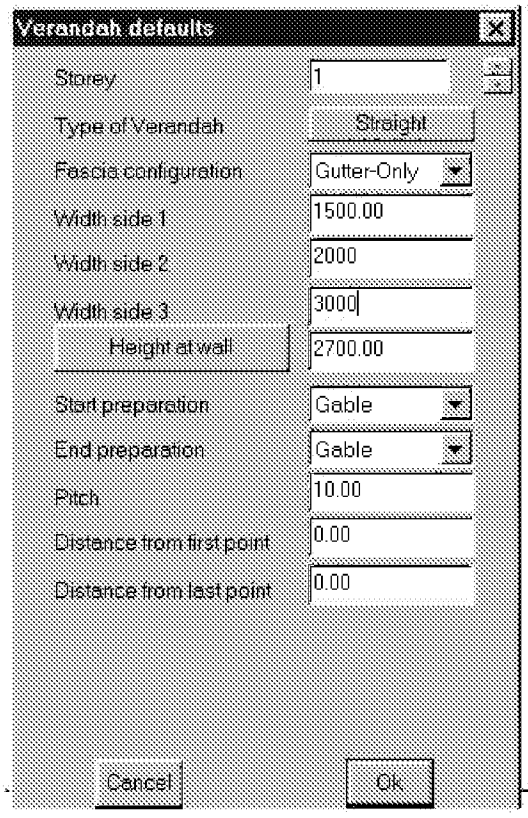
After you click **Ok**, the verandah is then drawn.

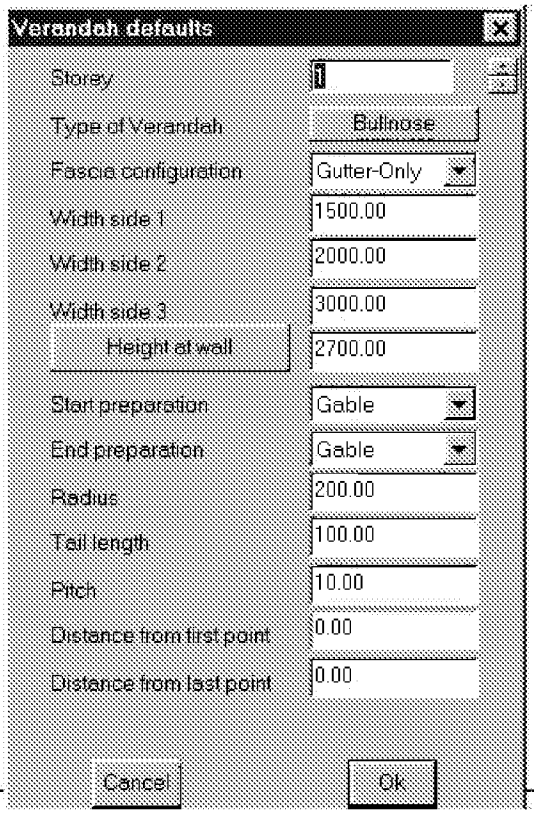
> To keep all the entities of the verandah together, they are grouped together as a set. You can disassociate this group by selecting **Delete** from the main menu. If you make a mistake and want to delete the verandah quickly, select Undo

Complex

When you click the **Complex** command, you then select successive lines which define the fascia alignment of the verandah. These lines need not be connected but successive lines must intersect. When you have finished selecting these lines, click the right hand mouse button.

Now, the first line remains highlighted for you to decide which side the verandah should be. After clicking a point, anywhere on the side you want the verandah, the Verandah defaults dialog is displayed. Here you set the parameters for the verandah.





Storey	You can set the storey of the verandah as 1, 2 etc. This makes it easier to separate the roofs making up each storey on screen. Also, various labor rates for estimating a roof can vary from one storey to the next.
Type of verandah	This button toggles between Straight and Bullnose (See below)
Width	This is the width of the verandah. Here you get a separate width for each line segment you previously selected
Width (n)	This is the width of the verandah. Here you get a separate width for each line segment you previously selected.
Height at wall	This button toggles between height at wall and height of gutter. The value you then enter alters the overall height of the verandah accordingly.
Start preparation	The start preparation can be one of Hip, Gable and Butts-Wall. Hip will draw a hip end on the verandah. Gable, makes the start of the verandah a gable end with barge flashing. Butts-wall makes the start of the verandah a gable end with apron flashing.
End preparation	The start preparation can be one of Hip, Gable and Butts-Wall. Hip will draw a hip end on the verandah. Gable, makes the start of the verandah a gable end with barge flashing. Butts-wall makes the start of the verandah a gable end with apron flashing.
Pitch	This is the pitch of the verandah
Distance from first point	This is the distance the verandah will start from the first point of the first alignment line. For your convenience, this point is flashing while the dialog box is displayed.
Distance from last point	This is the distance the verandah will start from the last point of he last alignment line

If you select a Bullnose verandah to draw, the dialog box has these extra parameters

Radius	This is the radius of the bend in the bullnose
Tail length	This is the vertical straight bit of the bullnose hanging down the fascia

After you click **Ok**, the fascia for the verandah is drawn. Now you would take time to see if this alignment is what you intended. If it isn't, then click the right mouse button to finish. If the fascia alignment is correct, you then select the wall lines to which you want the verandah to project to. You must select these all lines in the same general order as you defined the fascia lines. Also, the lines must be connected. When you have finished selecting the wall lines, click the right mouse button. The verandah is then drawn.

> Note : To keep all the entities of the verandah together, they are grouped together as a set. You can disassociate this group by selecting **Delete** from the main menu.

Delete

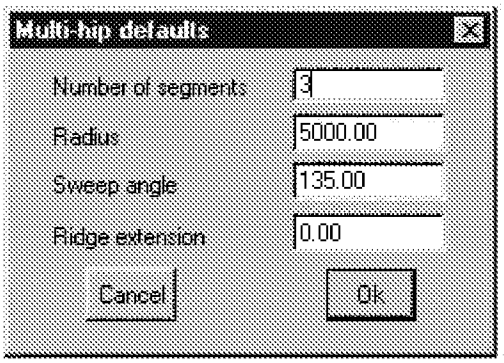
You can use this command to delete a verandah in the model. This command lets you select the verandah (which is grouped together as a set) and deletes the association as well as all the entities in the verandah.

> The **Delete** command on the main menu simply deletes the association and must be selected again to actually delete the entities.

Verify
This command simply reports information about the verandah in the prompt area at the bottom of the screen.

Multi-Hip

This command lets you insert a multi-hip roof. You can use this command for towers, spires and bay windows. You are first prompted to locate the apex point of the hips then the direction of the first hip. When you have done that, the Multi-hip defaults dialog box is displayed.



Number of segments this is the number of equal length segments to create. The minimum number is 3.

Radius this is the horizontal distance from the center of the tower along a hip.

Sweep angle this is the total angle you want the multi-hip roof to sweep from the initial direction you digitized around to the final hip in an anti-clockwise direction. For a circular tower, you would enter 360 degrees.

Ridge extension You can force a gable or hip end to project from the multi-hip by entering a non-zero length. This has no effect for a 360 degree sweep angle.

When you click ok, the multi-hip roof is drawn.

Copy

This command lets you copy a selected roof. After selecting Copy, you are then prompted for the number of copies. You then select all the roof planes you want to copy. You can select the planes individually, or by digitizing a window around the roof.
Then you digitise the initial point and final point. These points define the vector along which the roof is copied.

Move

This command lets you move a selected roof. After selecting Move, you then select all the roof planes you want to copy. You can select the planes individually, or by digitizing a window around the roof.
Then you digitize the initial point and final point. These points define the vector along which the roof is moved.

Rotate-2d

This command lets you rotate a selected roof. After selecting Rotate, you are then prompted for the number of copies and the rotation angle. You then select all the roof planes you want to rotate. You can select the planes individually, or by digitizing a window around the roof.
Then you digitize the rotation origin.

Mirror

This command lets you mirror a selected roof. After selecting Mirror, you are then prompted for the number of copies (0 or 1). You then select all the roof planes you want to rotate. You can select the planes individually, or by digitizing a window around the roof.
You then define the mirror axis by selecting a method on the text submenu.

Delete

This command lets you delete a selected roof. After selecting Delete you then select all the roof planes you want to delete. You can select the planes individually, or by digitizing a window around the roof.

Mod-Roof

After you have modeled the roof using the **Gen-Roof** commands, it is likely that you will need to modify the roof in some way. You may need to add a dutch-gable or a flying gable or cut out an atrium or add in a highlight window. You make those additions with the **Mod-Roof** commands. Most of these commands simply insert a gable roof and merge it with the main roof using meaningful terminology.

Hip-to-Gable

This command lets you change a hip end into a gable end.

After you select the command, you are prompted to locate the ridge attached to the hip. The hip end is automatically converted into a gable end. The line-types of the boundary lines are automatically changed accordingly.

> Remember : when you select the ridge, make sure you click on the ridge line close to the hip end you want to change. Otherwise, if there is a hip at the other end, that one will change.

Gable-to-Hip

This command lets you change a gable end into a hip end.

After you select the command, you are prompted to locate the ridge attached to the gable. Then you are prompted to enter the pitch of the hip end. After that, the gable end is automatically converted into a hip end. The line-types of the boundary lines are automatically changed accordingly.

Change-Pitch

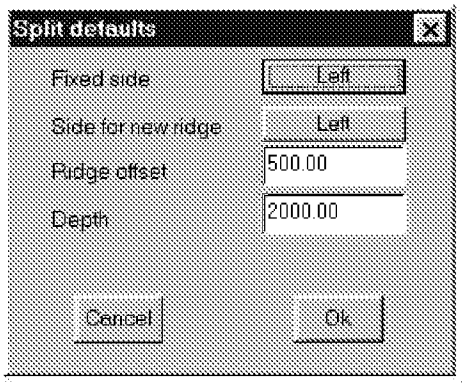
This command allows you to change the pitch of one or more roof planes.

After selecting the command, you then select one or more planes. When you have finished, click the right mouse button. Then you must enter the new pitch for the planes. After you have done that, the planes are recalculated.

> It is intended that only small changes in pitch are assumed. If you enter a large value, then the roof plane will still try to fit, but adjacent planes may not update as you desire.
>
> To select a plane, you can either select the tick mark in the corner of the plane or turn on the hatching of the planes by selecting **Utilities Show-Planes**

Split-Gable

This command attaches a gable roof to an existing gable end.
When you select the command, you are prompted to locate a ridge at the gable end. Then the Split defaults dialog box is displayed. This provides parameters for you to set values for the new gable.



Fixed side This toggles between Left and Right and assumes you are looking to the gable from the outside. If you select left, then the left hand side of the new gable matches the left hand side of the existing gable. Conversely for the right hand side.

Side for the new ridge This toggles between Left and Right, again as viewed from the outside, looking in. If you select Left, then the ridge of the new gable will be to the left of the existing ridge. Conversely for the right hand side.

Ridge offset This is the amount the ridges will be offset

Depth This is the depth (length) of the new gable roof.

After you click **Ok**, the new roof is drawn as well as merged with the existing roof.

Change-verge

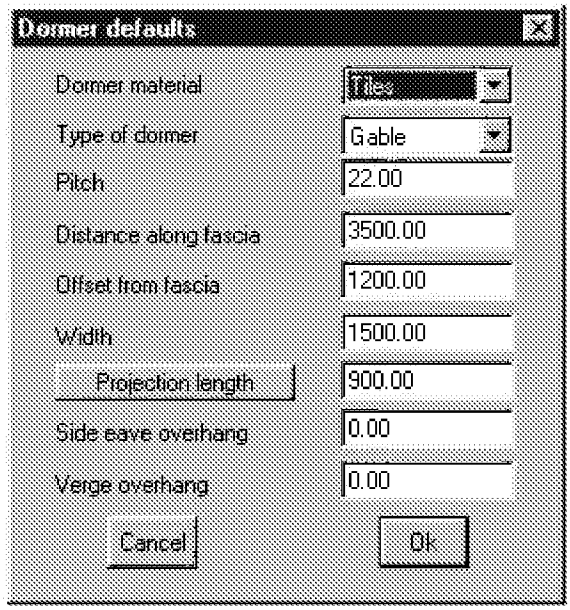
This command changes the verge (overhang) of an existing gable end. In effect, you can project a gable end along a ridge so the ridge becomes longer or shorter.

After selecting the command, you are prompted to locate the ridge at the gable end. Then you enter an amount to add or subtract to the verge. After you enter an amount, the ridge is lengthened or shortened depending on the sign of the value you enter.

Dormer

The Dormer command allows you to draw a dormer in one of several styles. The styles available are Gable, Hip, Skillion and Barrel.

To draw a dormer, click the **Dormer** command. You are then prompted to select a fascia. Selecting the fascia defines the plane the dormer will effect as well as the orientation of the dormer. The closer end you selected the fascia begins to flash, giving you a point of reference.
Now, the Dormer defaults dialog is displayed, letting you set the dormer parameters.



Type of dormer This is the style of the dormer which is one of Gable, Hip, Skillion or Barrel

Depending on the type of Dormer you selected, the following list of parameters can vary. The following list is for a gable dormer.

Pitch	This is the pitch of the dormer planes
Distance along fascia	This is the distance along the fascia to the center of the dormer. This is the distance from the lashing point.
Offset from fascia	This is the distance from the fascia to the face of the dormer
Width	This is the width of the dormer
Projection length	This is the length of the straight projection of the dormer. This toggles to Height of Dormer Gutter if you want to fix the dormer by height
Side eave overhang	This is the eave overhang on the sides
Verge overhang	This is the overhang of the gable end.

When you click **Ok**, the dormer is inserted.

> If you make a mistake and want to change the dormer, select Undo and start again

When you draw a dormer, a hole is created in the affected plane. The width and projection of the dormer define the size of the hole. The amount of actual roof coverage is the same as the hole plus the amount of eave and verge overhang.

If you select Hip or Skillion as the dormer style, you have the following parameter,

Front eave overhang	This is the overhang at the front of the dormer compared to the sides of the dormer.

If you select Barrel as the dormer style, you have the following parameter,

Diameter	The diameter of the curved roof.

> When a dormer is drawn, not only is the roof structure drawn but so are the sides. So, if you have to do any modifications to the dormer, keep in mind that the sides are plane entities also. That means, you will see tick marks in the corners and you cannot delete any of the dormer line work without deleting these side planes. If the dormer has a straight projection, the rake lines are tagged as a step flashing.

The storey to which the dormer refers is the same as the fascia you have initially selected.

Dutch-Gable

This command creates a dutch gable on a full hip or a flying hip. You need to know the horizontal distance from the base of the hip to the face of the new gable.

After you select the command, you are prompted to locate the ridge at the hip end. You will then notice a flashing line at the base of the hip that gives you a reference to measure from.

Also, the Dutch Gable defaults dialog is displayed which allows you to set the dutch gable



parameters.

Distance of gable from base of hip	This is the distance from the flashing line to the face of the gable. A value of zero will put the face of the gable at the base of the hip. A positive value offsets the face of the gable towards the ridge apex you selected. A

negative value offsets the face of the gable to the other side.

Verge overhang This is the verge overhang of the new gable

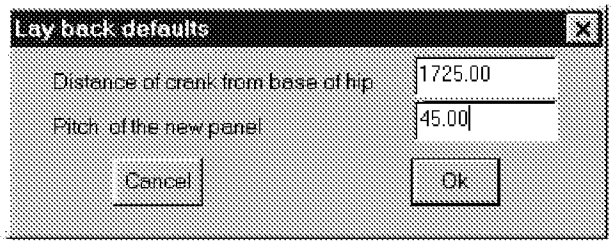
The base of the gable is automatically assigned as an apron flashing.

Lay-Back (Gambral)

You can apply lay back gable on a hip end or a gable end. You need to know the horizontal distance from the base of the hip to the cranking line as well as the pitch of the new plane.

After you select the command, you are prompted to locate the ridge at the hip end. You will then notice a flashing line at the base of the hip, which gives you a reference to measure from.

Also, the Lay back defaults dialog is displayed which allows you to set the lay back parameters.



Distance of crank from base of hip This is the distance from the flashing line to the cranking line. If the end is a gable, then it's the distance from the base of the existing gable o the next apex along the ridge.

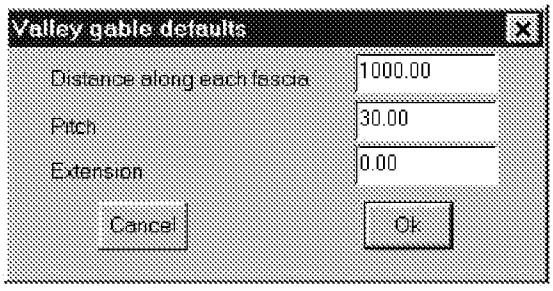
Pitch of the new plane This is the pitch of the new plane

Valley-Gable

This command inserts a gable at the base of a valley or a hip line. In effect, it automatically connects a gable into the corner of a roof.

After you select the command, you are prompted to select a valley line or a hip line. If the base of the valley/hip is connected to 2 fascia lines then we can proceed. If there aren't two fascia lines at the base then the command terminates with an error message.

Then, the Valley gable defaults dialog box is displayed. This allows you to set the parameters for the valley/hip gable.



Distance along each fascia This is the distance along each fascia. In essence this value defines the width of the gable.

Pitch This is the pitch of the two gable planes

Extension This is the length of straight from the intersection with the fascia to the actual gable.

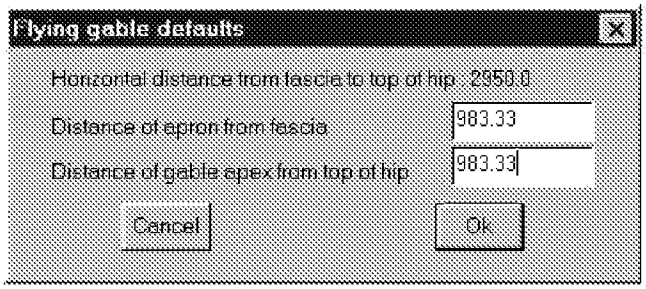
The two planes adjacent to the initial valley or hip line you selected are modified to accommodate the new gable roof.

Flying-Gable

This command inserts a gable along a hip line and modifies the relevant planes to suit.

When you select this command, you first select the fascia, which also defines the plane you want to deal with. Then you select the hip. This is the line along which the gable is inserted. It could be inserted from its bottom corner to its apex.

After that, the Flying gable defaults dialog is displayed which allows you to define the position of the flying gable.



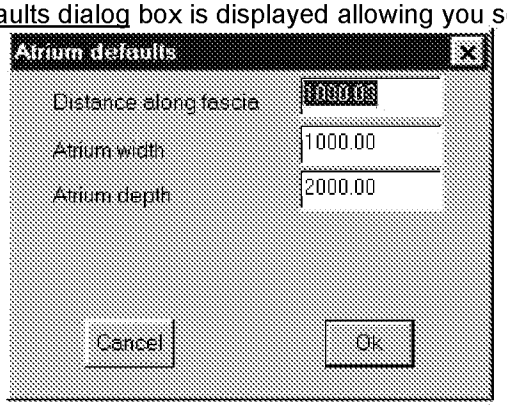
Distance of apron from fascia This is the horizontal distance from the fascia to the face of the gable. If you enter 0, then it draws the gable at the base of the hip.

Distance of gable apex from top of hip This is the horizontal distance from the top of the hip to where the valley of the new gable will intersect. If you enter 0, then this gable is wedged at the top of the hip.

Atrium

This command allows you to cutout a portion of the roof along a fascia creating an atrium. You can also create a drop down as well.

When you select this command, you are prompted to locate a fascia line you want to modify. After that the Atrium defaults dialog box is displayed allowing you set parameters for the atrium.



Distance along fascia This is the distance along the fascia that the cutout will start. It is measured along the fascia, from the end closer to where you selected the fascia. For reference, that end begins to flash.

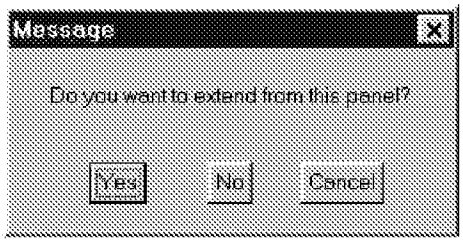
Atrium width This is the width of the atrium cutout

Atrium depth This is the depth of the cutout measured horizontally. If you enter a negative number, the atrium extends outward forming an overhang.

Highlight

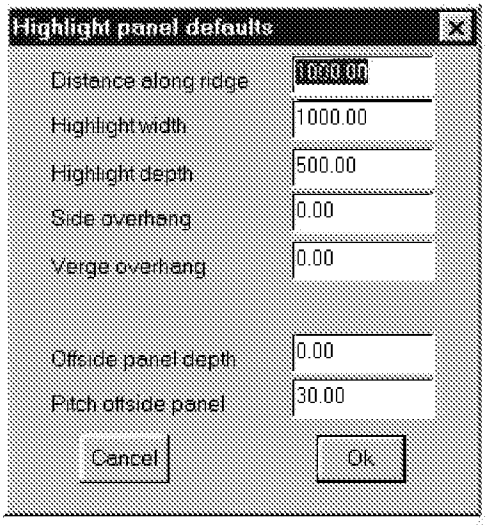
This command draws a highlight plane along a ridge as well as offside plane if you wish. It also modifies the offside roof plane by cutting a hole.

After selecting the command, you then click on the ridge you want to modify. Since each ridge can be connected to 2 planes, you are then prompted to determine which plane to extend the highlight plane from. You do this by clicking **yes** or **no** to the message dialog box which appears.



This message asks you *Do you want to extend from this plane?* and flashes the boundary of the plane for reference. If you want to extend from the offside plane, then click **no**.

After you have done that, the Highlight plane defaults dialog box is displayed allowing you to set parameters for the highlight window.



Distance along ridge This is the distance the highlight window will start from the end of the ridge you selected. For you reference, that particular end begins to flash.

Highlight width This is the width of the highlight window

Highlight depth This is the depth of the highlight plane

Side overhang This is the amount the edges of the highlight plane will overhang the resultant hole. If you enter zero (0), the edge of the highlight plane matches the resultant hole.

Verge overhang This is the amount the front of the highlight plane will overhang the hole

Offside plane depth This is the depth of the offside plane. If you set this value to zero, there will be no offside plane.

Pitch offside plane This is the pitch of the offside plane. The default value is that of the offside roof plane.

Once you click **Ok**, the highlight plane is drawn together with the offside plane (if you want one) as well as a hole in the offside roof plane.

> If you don't want a hole to be cut, then set the sum of the highlight depth and the offside plane depth to be the same as the verge overhang.
> ie if (highlight depth + offside plane depth = verge overhang) then no hole is cut.

Drop-Fascia

This command allows you to drop the fascia for a plane, based on a horizontal offset.

This is like the **Atrium** command (above), but assumes the full length of the fascia.
After you select the command, you are prompted to locate the fascia you want to drop. Then you enter the horizontal offset you want the fascia to move. Based on that offset as well as the pitch of the plane, the fascia is projected in the line of the plane, the horizontal amount you just entered. The net effect therefore, is to drop the fascia down.

> If you want to drop the fascia down by a specific amount, you would then enter dh/tan(pitch) in the dialog box, where dh is the amount you want to drop the fascia by, and pitch is the pitch of the plane in degrees.

Slice-Hip

The Slice-Hip command lets you lop off a portion of a hip end.

This situation may arise if the roof is to butt a property boundary or something similar.
After selecting the command, you are prompted to locate a fascia line. Then, you enter a station. The station is the position at which you want to slice the hip in relation to the selected fascia measured horizontally.

> You can only slice a hip end which is defined as a fascia that has a hip at either end.

By default, the two new raked flashing lines are assigned to be fascia. If you want to change them to something else (eg Barge), then use the **Utilities Cha-LineType** command.

> Remember, you can use the **Utilities Cha-LineType** command at anytime to change one line type to another.

Project-Gable

The project-gable command lets you realign a gable end to match a specific alignment (eg a property boundary) or to project the gable into an existing roof plane to form a raised or lowered entry way arrangement.

You would typically use this command to help join two roofs of different eave heights into one roof.

Assuming you have already drawn a gable roof and wish to realign the end to be other than square and you already have draw a line defining the new alignment of the gable end.

After selecting the command, you then locate the ridge connected to the gable end. Then, you select a menu item from the text menu. This is one of

2-Points	In this case you want the alignment of the gable end to follow the two points you are about to digitize
Line	In this case you want the alignment of the gable end to follow the line you are about to select.
Plane	In this case you want the gable end to project into the plane (roof plane) you are about to select.

If you selected 2-Points or Line, then you select the 2-points or line and the gable end is realigned where you tell it.

If you select Plane, then the gable end is projected along the ridge alignment to hit the target plane. Now, one of 5 things can occur in regards to automatically editing the target plane:

1. If the new roof is totally within the target plane, then a hole is punched to suit.
2. If the eave heights of the gable and the target plane are the same, then the fascia of the target plane is cut back to suit and the new roof is accommodated.

3. If the gable fascia is lower than the fascia of the target plane, then you are prompted to enter a tuck under distance. This is the amount, the fascia of the gable roof is projected under the target plane. Normally you would enter a value equal to the eave offset so the fascia runs into the wall. In this case, a lowered entry way is formed.
4. If the ridge of the gable roof is higher than the ridge of the target plane, then no automatic editing takes place.
5. If the ridge of the gable roof is lower than the fascia of the target plane, then no automatic editing takes place.

Advanced

The Advanced command provides a submenu of options, generally regarded as advanced for non-technical, non-CAD people. In short, these commands allow you to perform roof edits necessary to model unusual roofs.

In short, you can

- ⇒ insert new lines from one point to the next such as drawing in new hips, valleys and ridges.
- ⇒ move and copy existing lines
- ⇒ trim (extend) lines to hit other lines or roof planes
- ⇒ divide lines into smaller segments
- ⇒ insert roof planes individually by digitizing the lines which form the border of the plane
- ⇒ intersect lines and roof planes with cutting planes leaving points and lines respectively
- ⇒ cut a hole into a plane
- ⇒ merge two planes together
- ⇒ attach one plane onto another
- ⇒ perform random cut outs

The process for editing a roof involves 3 steps :

1. Identifying and deleting the roof planes which will be affected by the edits.
2. Trimming existing line work to suit or perhaps insert new line-work
3. Reinserting the new roof planes by digitizing line-work, which defines the boundary of the new plane.

> Remember : you may have to assign line-types to the new line-work (eg make a line a fascia etc) by using **Utilities Cha-LineType**. Also, you can make a plane a roof plane with the **Utilities Cha-Planetype** command.

Ins-Line

This command allows you to insert lines in one of several ways. When you select Ins-Line, the following submenu is displayed

Free	In this case you either digitize 2 points or enter coordinates to insert a line.
Hor-Len	To insert a horizontal line of a user defined length
Ver-Len	To insert a vertical line of a user defined length
Angle-Len	To insert a line a given angle and length from an existing line
Parallel=	To insert a line parallel to an existing line by a user amount

Move-Line

This command allows you to move a line from one point to another. The drag point for the line, is the end closer to which you selected the line.

> Remember : to locate this line at an exiting point, make sure you use the middle button which snaps to existing points. If you use the left mouse button, it will not snap to a close point.

Copy-Line

This command allows you to copy a line from one point to another. The drag point for the line, is the end closer to which you selected the line.

Trim-Line

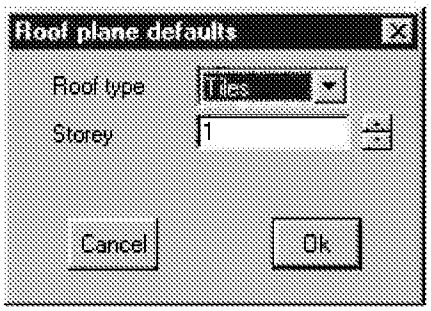
This command lets you trim one line to another.

You first select the line to trim at the end you ant to move, then select the line to trim to. Note that if the two lines do not truly intersect in 3D space, then the line will not be trimmed. Also, if the line is part of a roof plane, then it won't be trimmed either.
Apart from selecting a line to trim to, you could also digitize a point, or snap to an existing point. The resulting trimmed line will then be square off to that point.

Divide-Line
This command divides a line. The line may be part of a roof plane. You would use this if you want a line which has a fascia along its first half and noting along the second half.

Ins-Plane
This command allows you to insert a roof plane by selecting its boundary lines.
You need to select the boundary lines in successive order. If you select a line, not connected to the previous one, or you select a line not in the same plane alignment as those you have selected, you get an error message and prompted to select again.

When you select the last line, the Roof Plane defaults dialog is displayed from which you select the roof type and storey.



When you click Ok, the roof plane is inserted.

Cut-Line
This command lets you define a cutting orientation and intersect an existing line. You first define how you want to define the cutting plane in one of several ways

Line	The cutting plane will be defined by the selected line and projected up (in the Z)
2-Points	The cutting plane will be defined by 2 points and projected up
3-Points	The cutting plane is defined by 3-Points you digitize
Plane	The cutting plane is defined by a roof plane you select
CPL-XY	The cutting plane is in the XY plane
CPL-YZ	The cutting plane is in the YZ plane
CPL-XZ	The cutting plane is in the XZ plane

You would commonly use Plane as the cutting plane definition method. However, an understanding of each will only enhance your modeling capability.

After selecting the cutting plane method, you then define the cutting plane. (eg for Line, select the line, for Plane, select the plane). Then, you select the line you want to cut. If the cutting plane and line are not parallel, then a point is inserted at the intersection location.

You then use this point for construction purposes.

Cut-Plane
This command lets you define a cutting orientation and intersect an existing plane. You first define how you want to define the cutting plane in one of several ways

Line	The cutting plane will be defined by the selected line and projected up (in the Z)
2-Points	The cutting plane will be defined by 2 points and projected up
3-Points	The cutting plane is defined by 3-Points you digitize
Plane	The cutting plane is defined by a roof plane you select
CPL-XY	The cutting plane is in the XY plane
CPL-YZ	The cutting plane is in the YZ plane

CPL-XZ The cutting plane is in the XZ plane

You would commonly use Plane as the cutting plane definition method. However, an understanding of each will only enhance your modeling capability.

After selecting the cutting plane method, you then define the cutting plane. (eg for Line, select the line, for Plane, select the plane). Then, you select the plane you want to cut. If both planes intersect, then a line is inserted along the intersection.

You then use this line for construction purposes.

Hole
This command punches a hole into a selected plane.

After selecting the command, you select the roof plane you want to punch a hole in. Then you digitize around the hole using coordinates or existing geometry. Each point you select, is automatically projected onto the roof plane.

After you click the right mouse button, you close the hole outline and the hole is then punched.

Merge-Planes
This command forms one roof plane out of two.

After you select the command, you then select the two roof plane roof plane s you wish to merge. As long as the two planes are parallel, co-planer and share a common edge either fully or partially, a new roof plane will be formed.

Attach-Plane
This command allows you attach a new roof plane to an existing roof plane. The new roof plane may have a different pitch and fascia height.

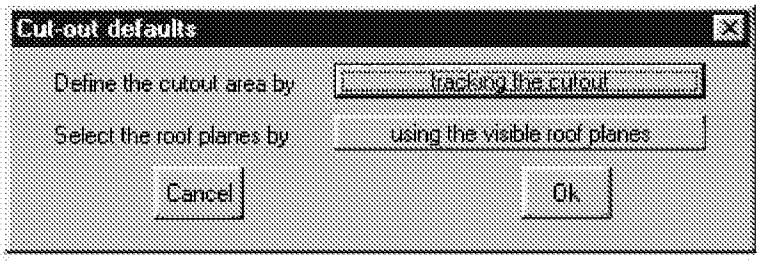
After selecting the command, you then select a line. The line must be horizontal, and attached to one roof plane. Otherwise you will get an error message.

You are then prompted to enter the pitch for this new roof plane as well as the fascia height for the roof plane. After you have done that, a rectangular roof plane is inserted, attached to the selected line.

Cut-Out
This command allows you to cutout parts of existing roof planes.

You would commonly use this to cut out the second storey shape from the first storey roof. You can however use this command at any time to cutout sections of roof planes.

The Cut-Out defaults dialog is first displayed, from which you set the method of defining the cutout shape and how you want to select the plane to cutout.



You can define the cutout area by either digitizing the cutout area or by tracking the cut out area. You can select the roof planes to cut out as the visible roof planes, or by selecting them yourself.

If you want the command to select the visible roof planes, you can use **Utilities Set-Display** to change the screen display (eg turn off second storey roof and first storey walls), so only the first or second storey roof planes are displayed.

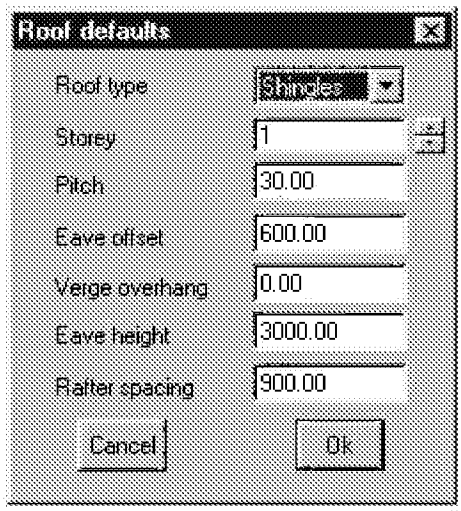
After you select click Ok, you then digitize or track around the cutout shape. After you close the outline, you then need to confirm that you want the visible roof planes cutout or to select the planes to cut. When you do, then all the selected roof planes are tested against the cutout shape. The parts of the roof planes within the cutout area are deleted.

Q-Roof

The Q-Roof menu gives you a set of commands which lets you digitize and/or construct a roof in a planametric fashion. You will either start with an architects blue-print, for new construction work, or your own field measurements for a re-roof job. In either case, the Q-roof commands let you simulate a 3d-roof while only concerned with a plan view. This approach is ideal if your roof is complex (has several eave heights and comprised of multiple roofs) and you want to provide a quick estimate for tiles, shingles or shakes.

Roof-Defaults

This command lets you set the roof defaults for subsequent roof plane insertion.

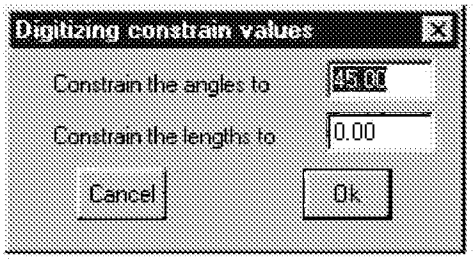


Zoom-Scale

Prior to digitizing a new roof, you can set the zoom scale to that of the plane. This gives you a good starting point in constructing the roof. You can use the Zoom commands at any time to zoom and scroll the roof model.

Draw-Lines

This is the basic command for drawing roof lines either by digitizing on a digitizing table, on-screen digitizing or input via coordinates. Typically you would have already placed your blue-print onto the digitizing tablet.
You first set the constrain angels and lengths so your digitized results maintain some regularity.



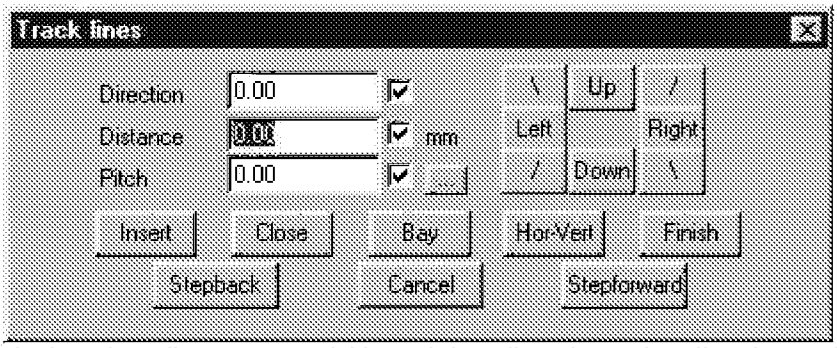
Then you proceed to digitize the roof shape.
When digitizing, “smart-snapping” is enabled by default. This means that the left mouse button will capture snap points automatically from existing points and lines. (Remember that the middle button will snap to existing points in the model). If you digitize close to a point, then that point is used. If you digitize along a line, then a point along that line is used (after complying with the constrain angle setting).

This process will insert lines into the model. These lines do not as yet know they are roof lines.

Track-Lines

When you select the Track-Lines command, cross hairs appear on the screen and you are prompted to digitise a starting point. (It is not important where you start on screen as the outline is automatically scaled to fit the screen).

After clicking the first corner, the Track Lines dialog box is displayed.



This dialog has been designed to allow you to quickly and draw lines base don direction and length.

The dialog box shows two fields labeled as Direction and Distance. The direction is a cardinal bearing starting at 0° up the screen, clockwise through 180° down the screen, and back up to 0/360°. The distance simply relates to the length of the line.

The accelerator buttons on the right hand side, are predefined directions with the following values

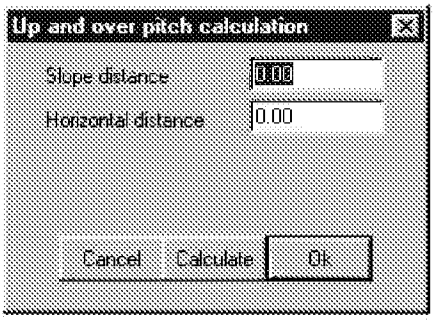
\ 315°	**Up** 0°	/ 45°
Left 270°		**Right** 90°
/ 225°	**Down** 180°	\ 135°

You can also use the letters u, d, l and r in the distance field to quickly get up, down, left and right directions. For example, you can enter r 5000 in the distance field to get a wall defined as right 5000.

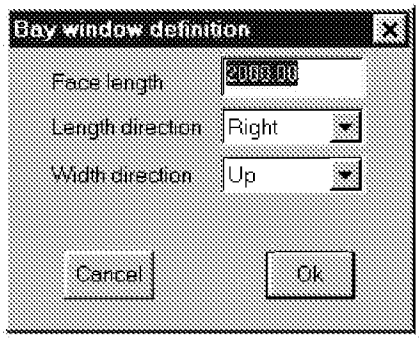
You simply click the appropriate accelerator button, enter the distance and a new wall segment is drawn on the screen.
You can enter a new wall by selecting the Enter key or clicking the **Insert** button.

If you make a mistake with a value, click the **Stepback** button.
You can undo a **Stepback** operation by clicking the **Stepforward** button. You can **Stepforward** as many segments you stepped back.
To close an outline, click the **Close** button. This will then display the Close dialog box from which you select a close method. You are then returned to the Track Lines dialog box.
To finish entering an outline, click **Finish**.

The distance you enter is also modified by the Pitch field. If this is zero, then the distance is horizontal, otherwise the pitch is used to reduce the distance to the horizontal. If you do not explicitly know the pitch but have “up and over “ measurements, you can click the ‘...’ button to the right of the pitch field to calculate the pitch.

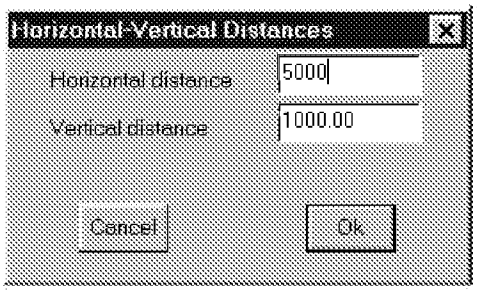


If you have a bay window, click the **Bay** button, This displays the Bay window definition dialog box which helps you draw a symmetric bay window.



Face Length This is the length of each face of the bay window
Length direction This is one of up, down, left or right
Width direction This is one of up , down, or left, right
The bay window is drawn when you click **Ok**.

If you only know the horizontal and vertical dimensions of the line (rather than its direction and length), you can click **Hor-Vert**. The Horizontal-Vertical Distances dialog box is then displayed.



Horizontal distance The horizontal distance (offset) of the line
Vertical distance The vertical distance (offset) of the line.
That line is drawn when you click **Insert**.

Bisect-Line

This command inserts a line between two other lines. It is designed to insert ridge lines between opposite eave lines, and hips and valleys between connecting eaves.

You first select the two lines. If the lines are not joined (as is the case for connected eave lines), a new line is automatically inserted mid-way between the two lines. If the two lines are connected, you need to digitize another point to define the side and length of the line.

Trim-Line

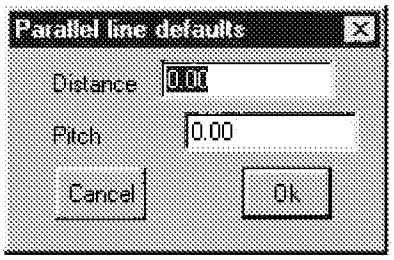
This command trims one line to another. You first select the line to trim at the trim end, then the line to trim to. You would use this process to define a hip end.

Divide-Line

This command divides a line at the point you select.

Parallel-Line

This command inserts a new line, parallel to a line you select. You first enter the parallel distance and slope.



Then you select the reference line followed by the side to place the new line.

Scale-model

This command lets you scale the roof model to suit actual measurements. If you digitized this roof from a tablet, the actual dimensions will only be close at best. You then need to scale the model. You first select a reference line, then enter the actual length of this line. The roof is then scaled based on the ratio of the drawn length of the selected line and the length you want to it be.

Set-LineType

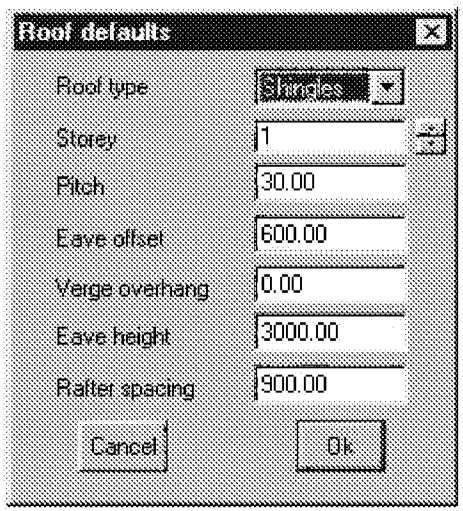
This command lets you assign to each line, the type of that line (Ridge, Valley, Hip etc)

Ins-Plane

This command lets you insert a single roof plane by selecting the boundary lines of the plane.

Gen-planes

This command automatically inserts roof planes onto all the closed loops in the model. If there are any unconnected lines in the model, you are advised and you can continue with the process or fix the problem. Also, duplicate lines in the model are detected and removed from the process. Duplicate lines are not deleted.
After generating the planes, the Roof defaults dialog is displayed. When you click Ok, the planes are then recognised as roof planes.



Note that there is always an extra plane inserted around the outer perimeter of each loop as part of the process which you may want to delete.

Cha-Pitch

This command lets you change the pitch of selected roof planes. There is no physical change to the roof planes. You can use Utilities Show-Pitches to quickly see the pitches assigned to each roof plane.

Hole
This command lets you punch a hole in an existing plane. You first select the plane, then you select the lines defining the hole.

Measure-Len
This command reports the plan length and the 3D length of the line you select.

Measure-Area
This command reports the plan area and the 3D area of the plane you select

Copy
This command lets you select and copy entities from one position to another

Move
This command lets you select and move entities from one position to another

Stretch
This command lets you select and stretch entities from one position to another

Rotate-2D
This command lets you select and rotate entities.

Mirror
This command lets you select and mirror entities.

Delete
This command lets you select and delete.

Underlay-On
This command lets you select and display an image underlay whether it be a bmp, tif or other image file. You would then use this underlay for on-screen digitizing of the roof plan..

Underlay-Off
This command turns the underlay off after you have turned it on.

Utilities

These commands allow you to do a variety of things such as

- ⇒ Display different categories of information
- ⇒ Change entities in the model
- ⇒ Dimension the roof
- ⇒ Handle key text strings

Show-Planes

This command automatically cycles through the model and draws a cross-hatch pattern on each roof plane. This is good for times when you need to select a roof plane for a command or simply to determine that roof planes are indeed present. It also acts like a toggle where new planes you draw later on will automatically be hatched.
The default hatch differs depending on the type of roof material on the roof plane. For tiles, shingles and shakes, the hatching runs along the plane; for metal, the hatching runs up the plane and for Low-Slope roofs, the hatching runs at an angle of 35 degrees across the plane. This helps you visually differentiate what is on each roof plane especially when you want to combine materials.

Hide-Planes

This command turns off the hatching generated by Show-Planes. This acts like a toggle also, but will cause new planes you draw later on to have no hatching.

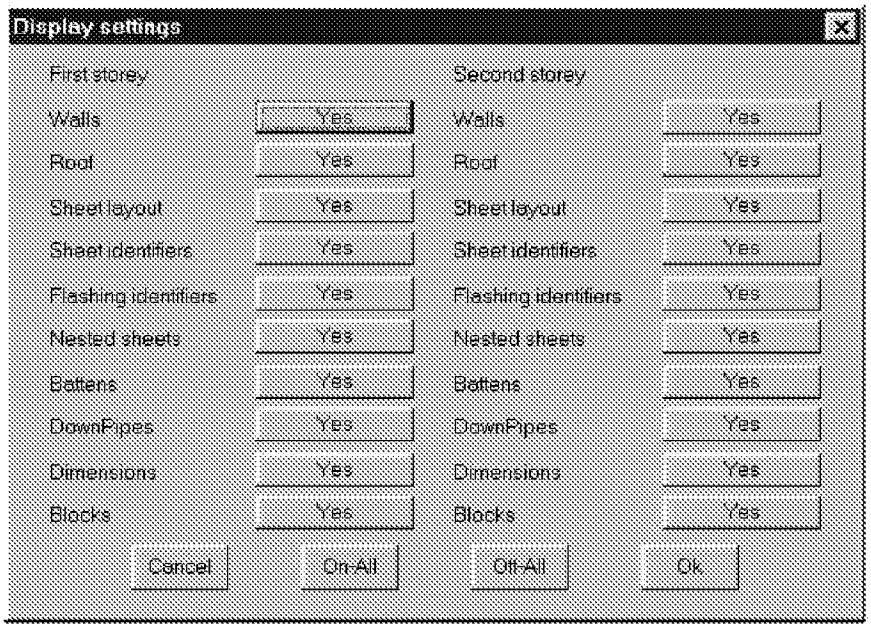
Show-Pitches

This command automatically displays the pitch/slope on each roof plane in the model. These labels disappear after a repaint.

Set-Display

This command allows you to mask different categories of information from your current display. The information is separated between first and second storey elements.

When you click the command, the Display settings dialog box is displayed.

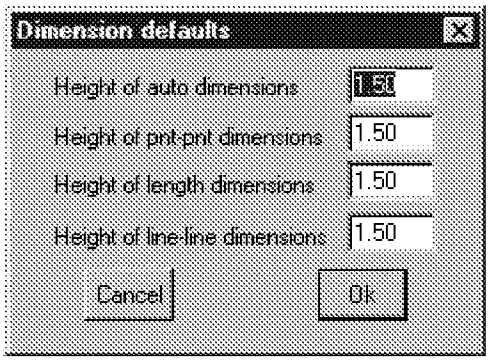


Each button is a yes/no toggle which simply turns that information on or off. If you click **O**n-All or **Off-All** then all settings are changed to Yes and No respectively. When you click **Ok**, the screen is repainted with the relevant information.

Dimension-Roof

This command displays a sub-menu which allows you to add dimensions to the roof automatically or manually.

Defaults



After selecting **Defaults**, the Dimension defaults dialog is displayed.
These options allow to alter the size of dimensions for the four different methods. You will see the effect on screen, and on the drawings.

Insert-Auto
This dimensioning command inserts dimensions automatically around the outside of the roof. Running dimensions are automatically inserted along the top, right, bottom and left hand sides of the roof model.

Insert-Pnt-Pnt
In this case, you first locate the two points you wish to dimension, followed by the position for the dimension.

Insert-Line-Line
In this case, you first locate the two parallel lines you wish to dimension between. The dimension will represent the 3D distance from the first line to the second line. The position of the dimension is the same point at which you selected the first line. You would use this dimensioning command to detail the rafter length on a roof plane. Note that if the lines you select are not parallel, the dimension is not inserted.

Lengths
This command annotates the dimension of each roof line (except for aprons). The dimension is rounded to the nearest mm and truncated.

Move
This command lets you move the dimension text so it does not over-write another part of the drawing

Delete
This command automatically deletes all the dimensions in the model including the pnt-pnt dimensions.

> The size of the dimensions are plot scale dependent. That means, the smaller the plot scale, the smaller the dimension text will be on screen. To view the dimensions on screen, make sure the plot screen setting is suitable (perhaps 1:200). You can change the plot scale by selecting **View Plot-Scale**

The dimensions are plotted with the roof drawings using the **Reports** command. You can also plot them using the **Plot** command.

Project-Walls

This command automatically projects the wall lines in the model down by an amount you enter. After you select the command, you are prompted to enter the wall height. The defaults value is the eave

height you have entered earlier. Then, all wall lines are automatically projected down by the amount you entered.

Cha-LineType

This command allows you to change the line type to another line-type or to nothing.

For modeling and estimation purposes, each line is given a line type automatically. Here you can change each line on a line by line basis.

After you select the command, you then select the lines to change. Then, a sub-menu is displayed displaying the different line types available. You then select one of the line types. By doing so, the color of the line may change as well as the tag will change. (You can use **Verify** to see what the tag actually is in full).

The table below describes the menu item, the tag the system assigns, and how the flashing is reported.

Line Type	Tag	Reported flashing
None	NONE	Ignored
Ridge	RIDGE	Reports ridge flashing
Valley	VALLEY	Reports valley flashing
Hip	HIP	Reports hip flashing
Fascia&Gutter	FASCIA	Reports both fascia and gutter.
Barge&Fascia	GABLE	Reports both barge and fascia flashings.
Fascia-Barge	FASCIA-BARGE	Only reports fascia flashing.
Fascia-Only	FASCIA-ONLY	Only reports fascia flashing.
Gutter-Only	GUTTER-ONLY	Only reports gutter.
Barge-Only	BARGE-ONLY	Only reports barge flashing.
Apron	APRON	Only reports fascia flashing.
Tuck-Under	TUCK-UNDER	Ignored
Box-Gutter	BOX-GUTTER	Only reports as a box gutter
Step	STEP	Reports the step flashing

Cha-PlaneType

This command allows you to change the type of plane to a roof plane or to None.

Changing to none has the effect of the system not recognizing that plane as a roof plane in its calculations.

Cha-PlaneMat

This command allows you to change the material assigned to a roof plane. After selecting the plane to change, a submenu of Tiles, Metal and Low-Slope, is displayed. The plane material is then changed to the one you select.

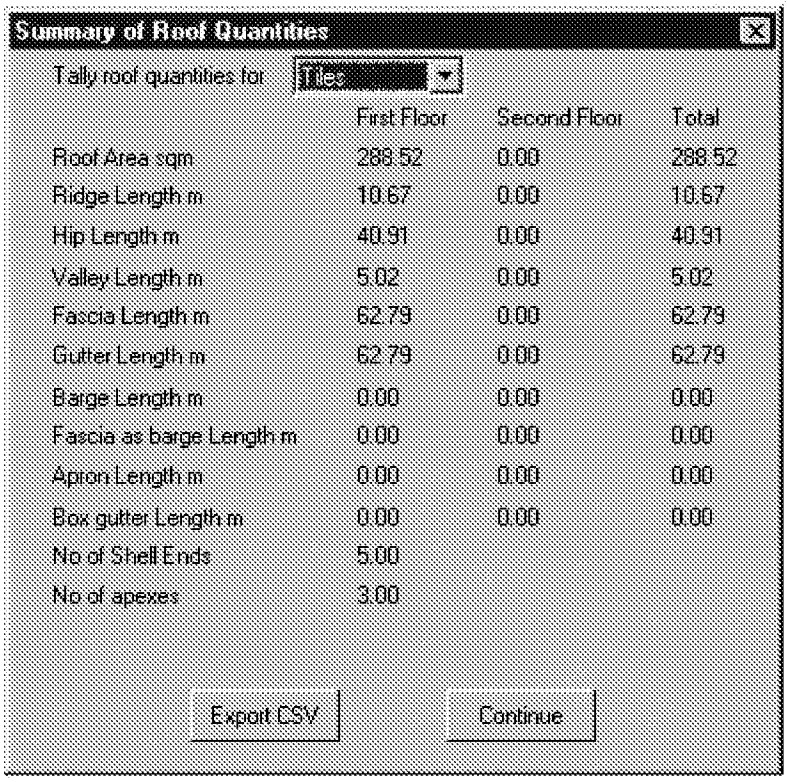
> You can determine the roof plane material by selecting the Verify command from the main menu, then selecting a plane. You can then read the tags on the plane. The plane material is stored as a ROOFMAT tag.

Tally-Quantities

This command automatically reports the geometric lengths and area of the roof and roof lines.

You also are told the number of shell ends as well as the number of apexes. For convenience, the values are differentiated based on storey and type of roof material.

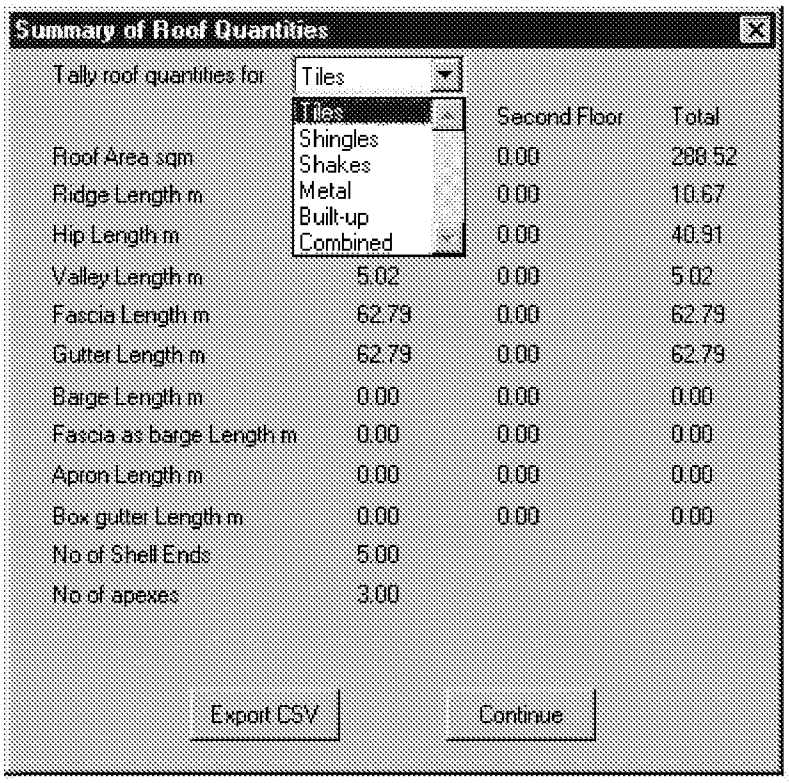
After you click this command, the Summary of Roof Quantities dialog box is displayed



If you wish to export this information to another computer system you can click the **Export CSV** button which will write a comma separated value file automatically.

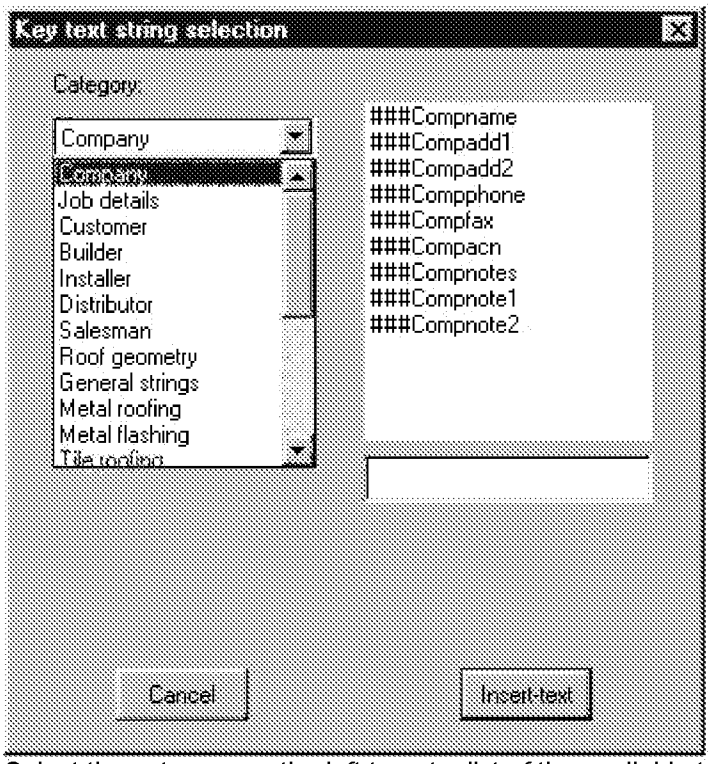
If you had generated offset roof planes using **Estimate Offset-Roof**, the area of the offset roof planes is also displayed.

You can separate the areas based on roof materials or get a combined set of values depending on the setting in the drop down box.



Ins-KeyText

This command lets you insert key text strings into the model. You would actual do this in a template report file.



Select the category on the left to get a list of the available text strings on the right.

Ins-Text

This command lets you insert any text you enter text strings into the model.

Text-Defaults

This command lets you set the defaults for text insertion.

Cha-Text

This command lets you change the appearance of an existing text entity.

Move-Text

This command lets you move a text entity from one location to another.

Copy-Text

This command lets you copy a text entity from one location to another.

Edit-Text

This command lets you edit an existing text entity.

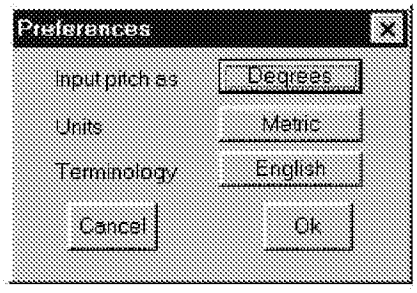
Delete

This command lets you delete an existing text entity from the model.

Preferences

This command sets the units, slope input and terminology of your installation. You should only have to set this once.

When you select **Preferences**, the Preferences dialog box is displayed.



Input pitch as	This is either Degrees or Slope (in 12)
Units	This is either Metric or Imperial
Terminology	This is either English or American.

The differences in terminology are

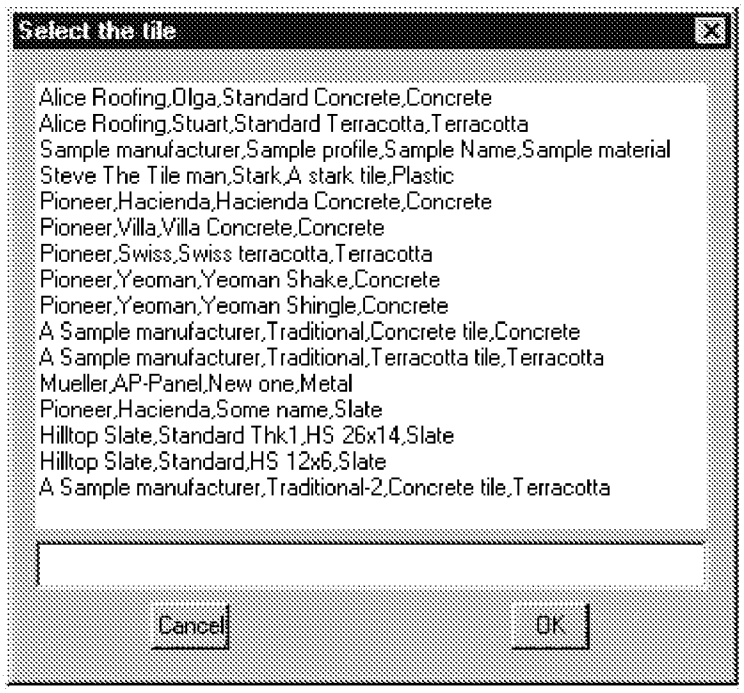
Aust/English	**US**
Sarking	Underlay
Battens	Purlins
Verandah	Porch
Cartage	Delivery
Downpipe	Downspout
Shell end	Hip starter
Apron	Skirt
Barge	Rake
Colour	Color
Labour	Labor

Cover

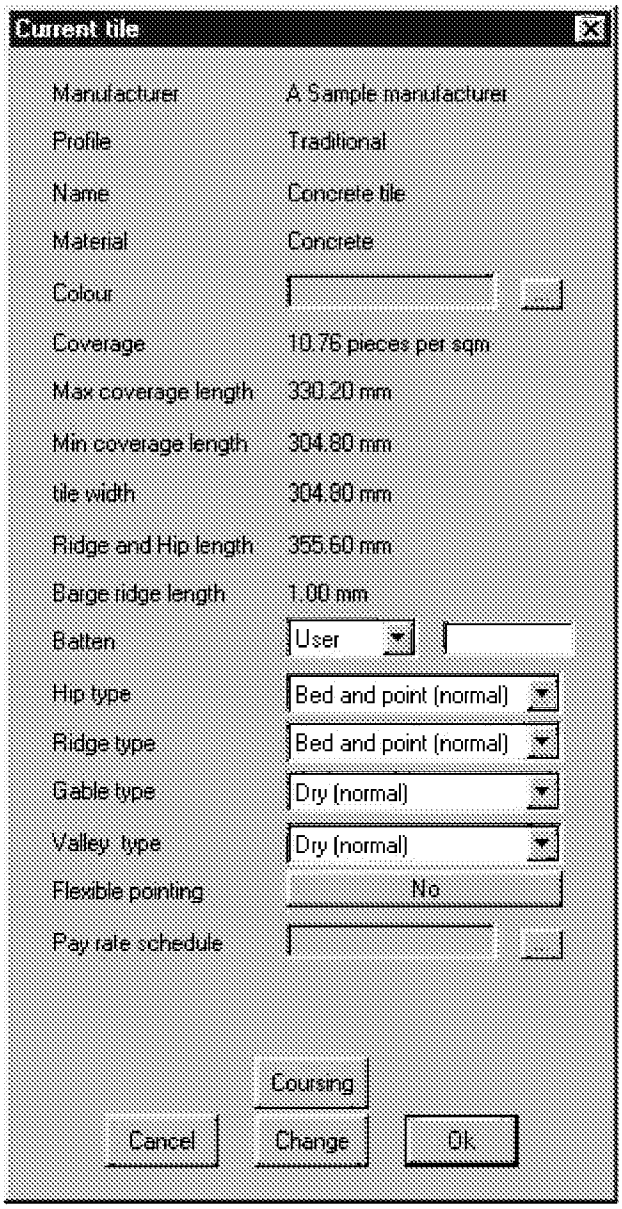
The cover commands allows you to set the roof cover material, flashings material as well as the insulation, downpipes and battens.

Select-Tile

This command lets you select the tile for the job as well as other tiled roof parameters. When you first select **Select-Tile**, the Select the tile dialog box is displayed.



Once you have selected a tile, click **Ok** and you get the Current tile dialog box



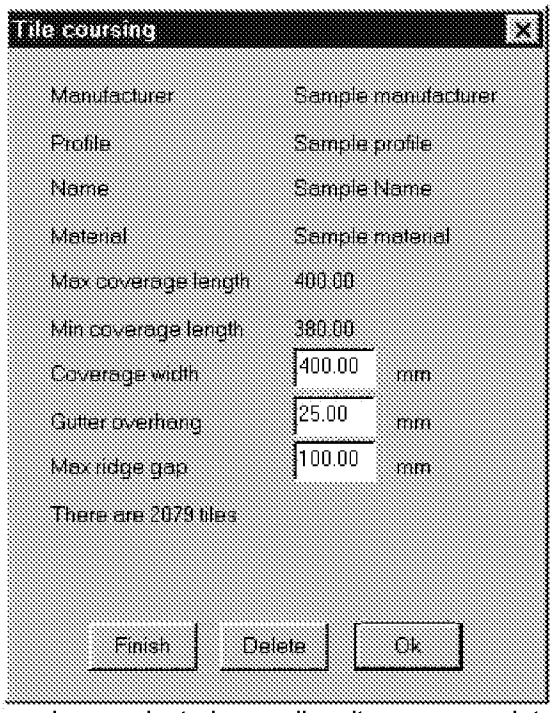
This dialog reports to you the coverage as well as other geometric values for the selected tile. Refer to **Cover Define-Materials Tiles** command to see how you can define and change a tile definition.

Color	This button lets you select a color from a list of colors provided by that manufacturer
Batten	To select a batten for the job, select the appropriate size from the **Batten** combo box.
Hip-type	Hip Type is one of, Bed and point (normal), Seal and Butt
Ridge-type	Ridge Type is one of Bed and point (normal), Seal and Butt
Gable-type	Gable Type is one of Dry (normal), Bed and point, Seal and Barge ridge (this is actually a different tile whose cost needs to be provided under cover costs)
Valley-type	Valley Type is one of Dry (normal), Bed and point and Seal
Flexible pointing	This is either Yes or No
Pay rate schedule	Clicking in this field will display a list of the pay rate schedules you have defined. Refer to the **Costing Tile-Pay** command to see how you define a pay rate schedule.
Starter course	Clicking in this field will a list of shingles or shakes you can use as the starter course. The starter course is applied to all eaves as well as to rake edges when using shingles. This filed only appears in the **Select-Shingle** and **Select-Shake** commands

To cancel the tile selection click **Cancel**
To change the tile selection, click **Change**.
To accept the tile selection, click **Ok**. Then, this becomes the cover material for all the tile roof planes in the model.

Coursing Clicking in this button lets you perform an estimate by simulating the laying of the courses for the tiles. If you do not want to estimate by coursing, you can ignore this step and the estimate will default to the area method.

When you select **Coursing**, the Tile coursing dialog box is displayed.



This dialog displays the tile you have selected as well as its coverage data. The maximum and minimum coverage lengths are set when you define the tile.

Coverage width this is the effective width of the tile

Gutter overhang this is the amount you want to have the first course to overhang into the gutter. You can also use this value to effectively offset the location of the second course.

Max ridge gap this is the maximum gap between a ridge and the top of the closest course. That is, a course is not inserted if it falls within this value.

For any of these fields you can enter whatever values you like to obtain the result you desire.

When you click **Ok**, coursing lines are inserted onto the roof planes.
If you click **Delete**, the coursing lines on the roof are deleted.
If you click **Finish**, then the command terminates and the dialog box closes.

For each roof plane, the eave course is laid from the longest fascia. From there, an optimum course separation is calculated which will fall between the maximum and minimum values relevant to the tile. Note that the start of the eave course is determined by the gutter overhang.

After the courses are drawn, the number of tiles (excluding waste) is reported on the dialog box. You can determine the waste when you prepare the quote.

Select-Shingle

This command lets you select the shingle for the job as well as other shingle roof parameters. When you first select **Select-Shingle**, the Select the shingle dialog box is displayed. Refer to the **Select-Tile** command above as the operation is the same.

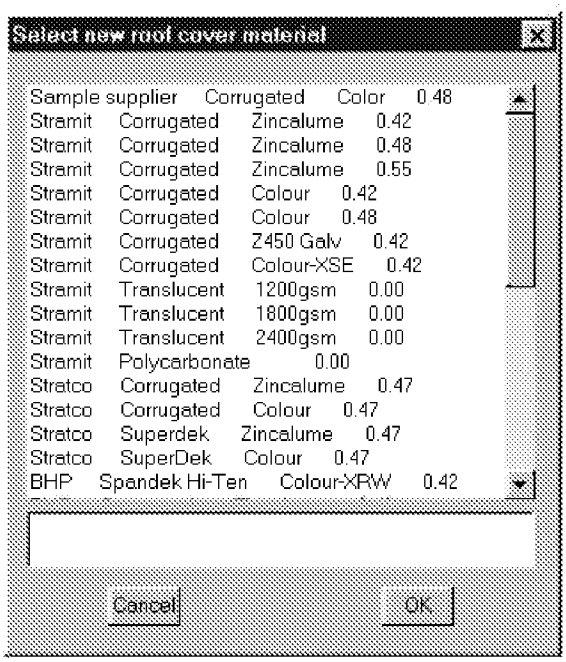
Select-Shake

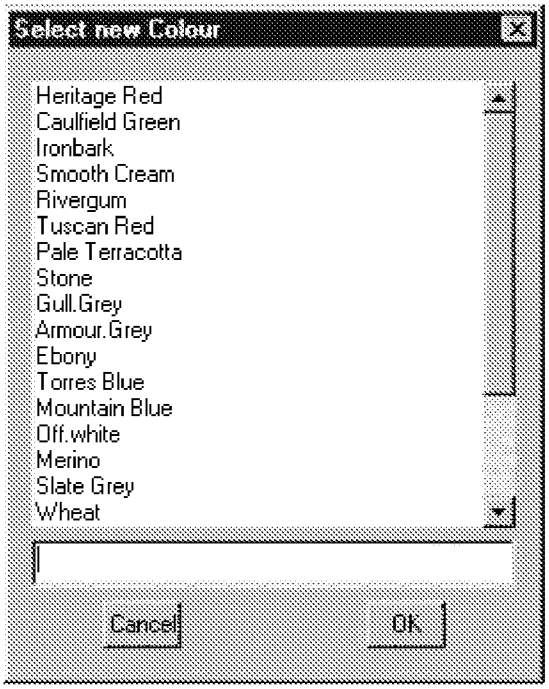
This command lets you select the shake for the job as well as other shake roof parameters. When you first select **Select-Shake**, the Select the shake dialog box is displayed. Refer to the **Select-Tile** command above as the operation is the same.

Select-Metal

This command sets the straight roof material as well as the curved roof material (for a bullnose verandah). These become the global materials for the whole job.

After clicking **Select Metal** for the first time, you first select the type of cover you want from the Select new roof cover material list box. If you choose colorbond material, then a listing of all the appropriate colors is displayed.





After you click the color you want, the Roof cover material dialog box is displayed.
This dialog displays to you the material you have selected for the straight roofing as well as the curved roofing.

To change the selection, click on **Change** and select the new roof cover.

To change the color, click on the color label button and a list of colors will be displayed.

To change the fastener, click in the fastener field, and the list of fasteners is displayed.

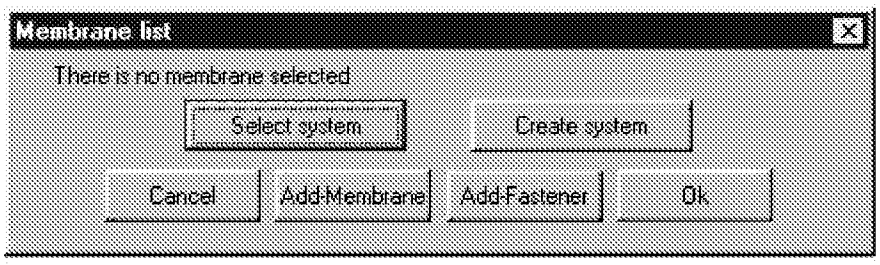
To change the number of fasteners per square meter, simply enter a new number.

When you click **Ok**, those settings are saved as the global cover materials for this job. The roof cover material you have set applies to all roof planes in the current job.

Select-Membrane

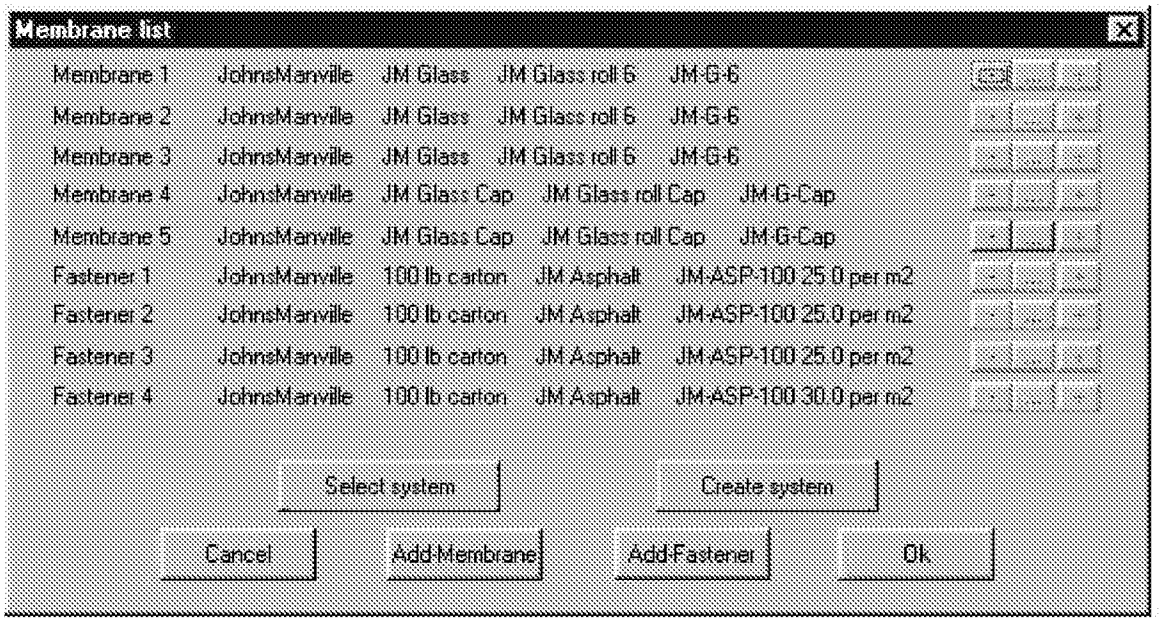
This command allows you to assign membranes to the entire roof or simply to parts of the roof. You can even assign areas which have no membrane material. When you click this command, a sub-menu is displayed.

Select-default
This option allows you to set the membrane for the entire roof. When you first click this command, the Membrane list states there are no membranes selected.



When you click **Add-membrane**, the list of available membranes is displayed. You do this for each of the membranes you want. When you click Add-Fastener, the list of fasteners is displayed. You then enter the application rate for this fastener. The membranes and fasteners are displayed separately in the dialog. The order is not relevant for the estimate.

You can select up to 20 different membranes.



When you click **Select system**, a list of membrane systems is displayed from which you can select one. After you do select one, the list of membranes associated with this system is displayed.
You can create a system by selecting **Create system**. This lets you create a system from the list of membranes you have selected.

The manipulation buttons to the right of each line item are
- Delet this line
... Change this line
+ insert an item before this line

When you click **Ok**, the list of membranes you have selected applies to all Low-Slope roof planes in the job.

Apply-to- Plane

This command allows you to apply membranes to a single plane, independent of the global settings. You first select all the planes you want to change, then build the list of membranes you want. Those membrane settings are then stored with that plane.

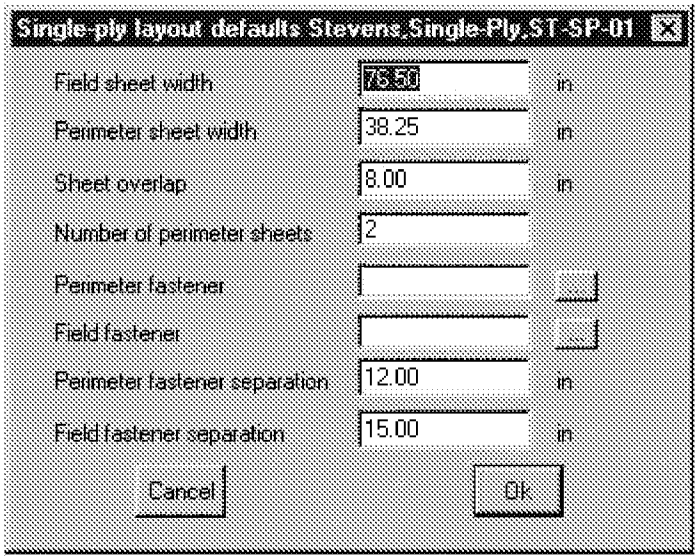
Remove
This option allows you to have no membrane applied to the selected plane. First you select one or more planes. When you accept the selection, those planes will be marked as having no membrane.

Reset-Plane
This command allows you to reset all the planes in the job to adopt the global membrane list. That is, it removes any user defined changes you have made.

Negative-plane
Here you can insert a negative membrane area. After you digitize points defining the extent of the area, a plane is inserted. When the total amount of membrane is tallied later on, this area will be subtracted from the plane area to leave a nett membrane area. You can select the type of membrane for this negative area the same way you do for a standard plane.

Verify
This command displays in a dialog box, the membrane associated with a plane you select. It also notes if the plane is actually a negative area.

Layout-SPly
This command lays out single-ply membrane on a low-slope roof allowing for different perimeter and field sheets and fasteners.
When you select the command, you first select the membrane manufacturer you want to use. Then the Single-Ply layout defaults dialog box is displayed.

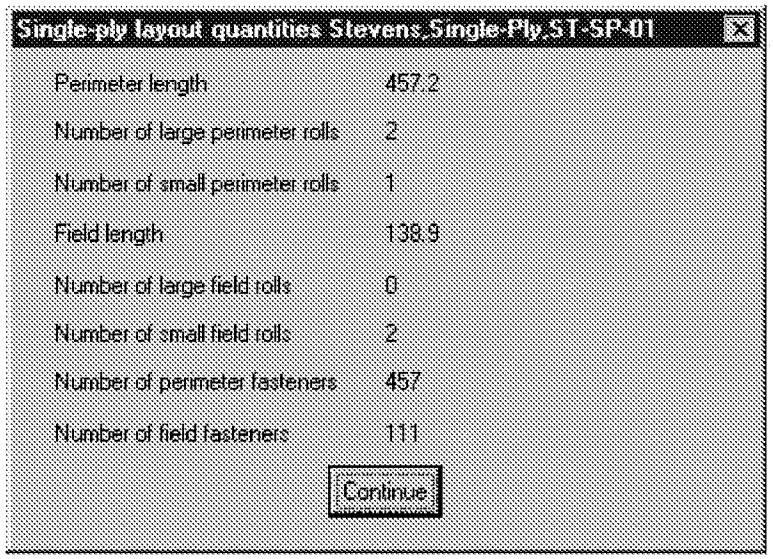


Field sheet width	The width of the field sheets
Perimeter sheet width	The width of the perimeter sheets
Sheet overlap	The width of the perimeter sheets
Number of perimeter sheets	The number of perimeter sheets you want to use
Perimeter fastener	The fastener you want to use for the perimeter sheets
Perimeter fastener separation	The fastener spacing for the perimeter sheets
Field fastener separation	The fastener spacing for the field sheets.

You would use Cover Define-materials Membrane to define the sheet widths.

When you click Ok, you select the roof plane you want to lay the membrane on. You will notice that the perimeter sheets are then constructed around the perimeter of the roof plane. You are then prompted to select a line which defines the direction of the field sheets. The field sheets will be laid parallel to the line you select. Then, you need to locate a position through which a seam will occur.

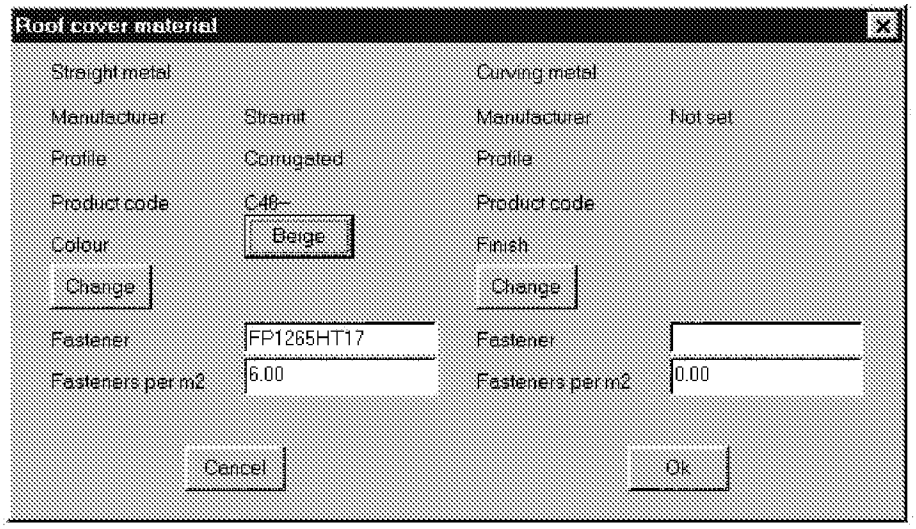
After the field sheets are constructed, a material report is displayed detailing the number of perimeter and field sheets, as well as the number of fasteners.



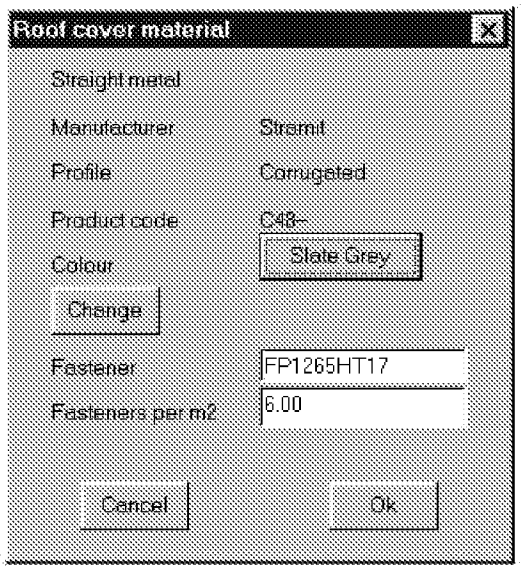
Click Continue to finish the process.

One- Plane

This cover command allows you to assign a different metal roofing material to a single plane from the global cover material you selected above.



When you click this command, the Roof cover material dialog box is displayed.



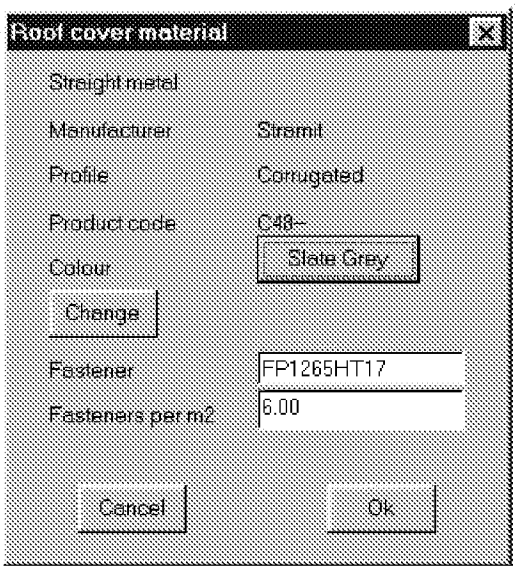
Here you should set the new material configuration you want. You will notice that only the straight roofing material is displayed.

After you click **Ok**, you then select the roof planes you want to adopt this material.

Verandah

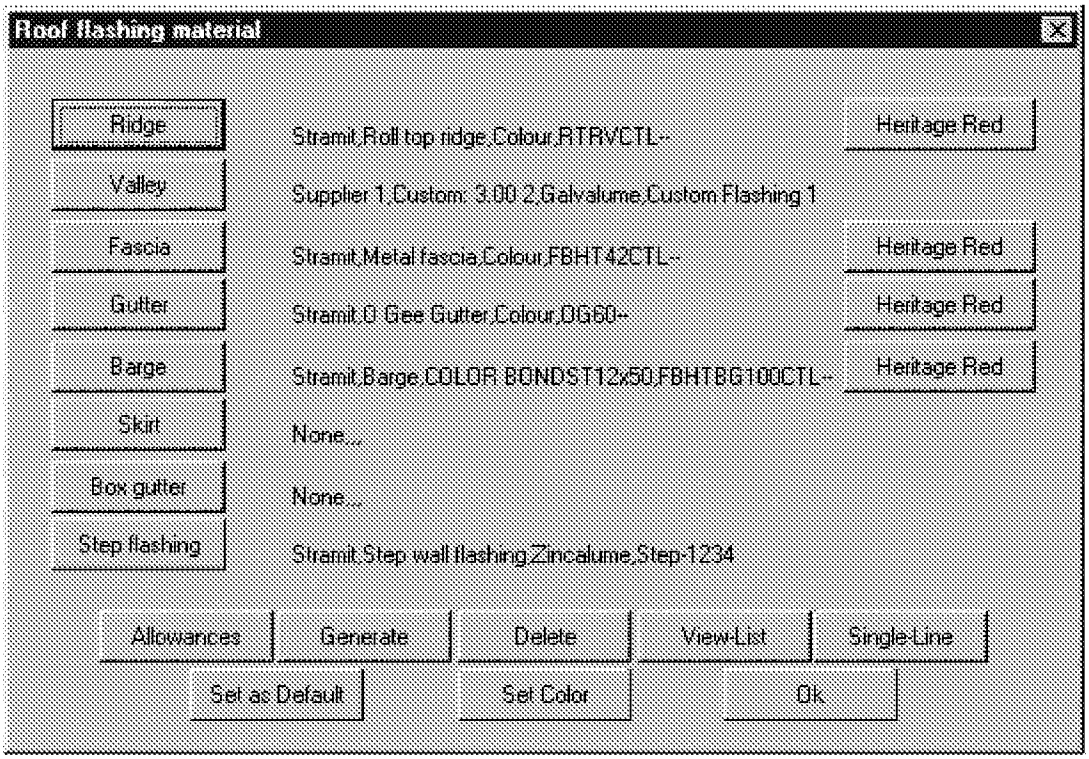
This command allows you to select the cover material for a verandah. If you don't, then the verandah will adopt the material from the global settings - straight verandahs will adopt the straight material, and bullnose verandahs will adopt the curved material.

After you select the command, you then select the verandah. Then, the Roof cover material dialog is displayed at which you select the cover material you want.



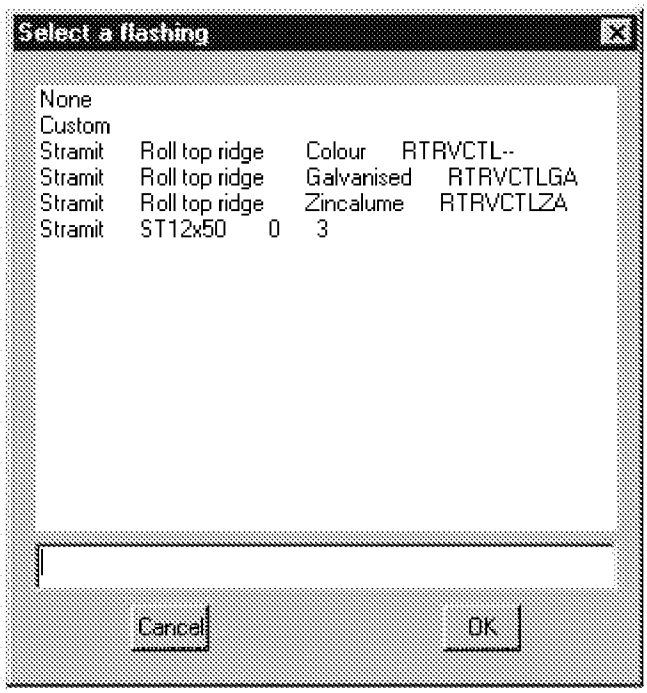
Flashings

This command allows you to set the flashing you want for each of ridge, valley, fascia, gutter, barge, apron, box gutter and step flashing. These become the global settings for each of the flashing types. You can select predefined flashing or define custom flashings.



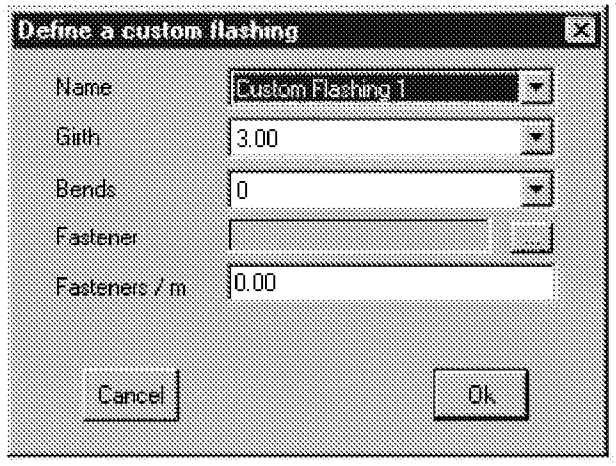
After you select **Flashing**, the Roof flashing material dialog box is displayed.

To select a new flashing type, click the relevant flashing button (Ridge, Valley, Fascia etc). Then, the Select new flashing list box is displayed.



Here you will see the list of relevant flashings (ridge flashings in this case). If you don't want ridges to be tallied in this job, select **None** as the flashing type.

You can also select a custom flashing to be used for this flashing by selecting Custom from the flashing list. After you select Custom, the Define a custom flashing dialog box is displayed.



Name This is the name of the custom flashing table you defined under **Cover Define-Materials Custom-Flashings**. This table defines the fabrication cost given a matrix of girths and bends.

Girth This is a drop down box of girths defined in the relevant table

Bends This is a drop down box of bends defined in the relevant table

Fastener This is the fastener you want to use for this flashing. To select a flashing, click the button on the right hand side.

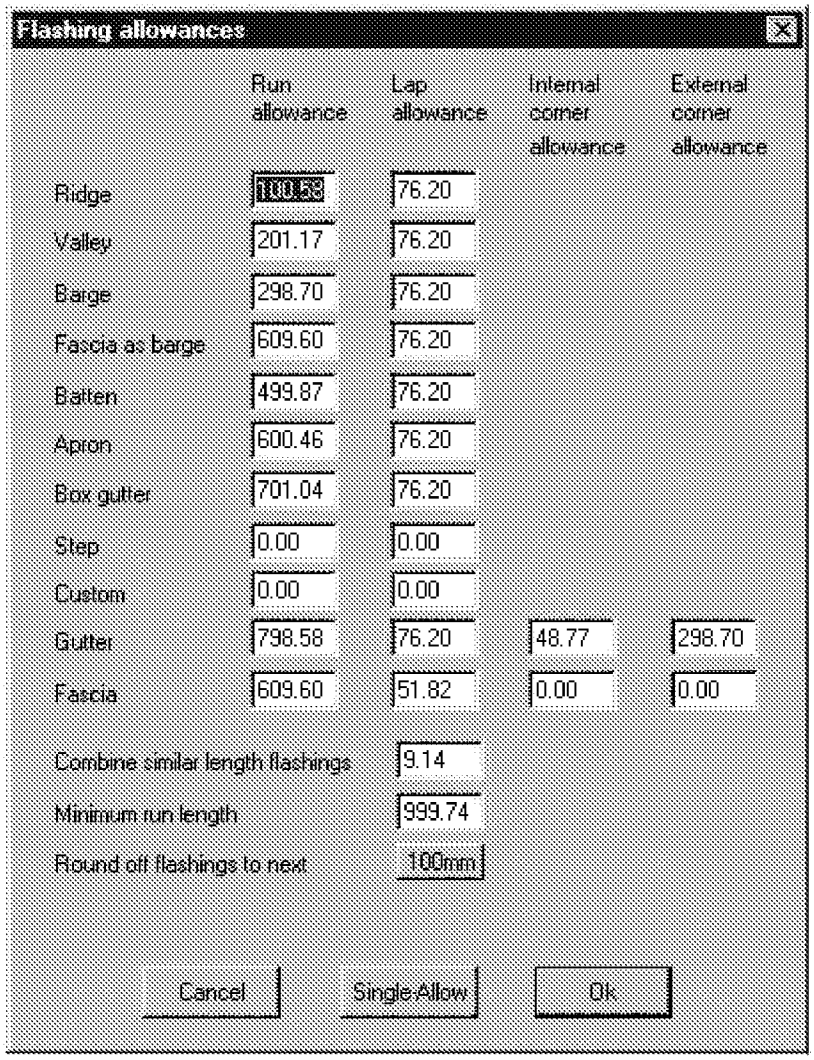
Fasteners/m This is the number of fasteners you want per unit length

When you click Ok, you are returned to the Roof Flashing Material Dialog box describing the flashing you selected. Refer to the dialog box above where the Valley flashing is defined as a Custom flashing.

To change the color of a painted flashing, click the color button on the right hand side. This will then display the Select color list box. From which you select the color you want.

Allowances

To set the flashing allowances, click the Allowances button.



Here you can set the standard allowances you ant to add to each flashing type and sheet. After you select this command, the Flashing Allowances dialog box is displayed

Run Allowance. This is the amount added to each run regardless of the length of the run. You can treat this value as an end allowance.

Lap Allowance This is the amount you want to add to take piece overlap into account

Internal corner allowance This is the amount you want to add to a gutter or fascia run if there is an internal corner at an end.

External corner allowance This is the amount you want to add to a gutter or fascia run if there is an external corner at an end.

Combine similar length flashings After you generate a flashing list, lengths which are less than this amount apart, are assumed to be the same length and are merged together. The shorter lengths are merged into the longer lengths.

Minimum run length This is the minimum run length which will be treated as an independent run. Runs less than this length will be added to an attached run.

Round off flashings to next This toggles between 10mm and 100mm

Single-Allow

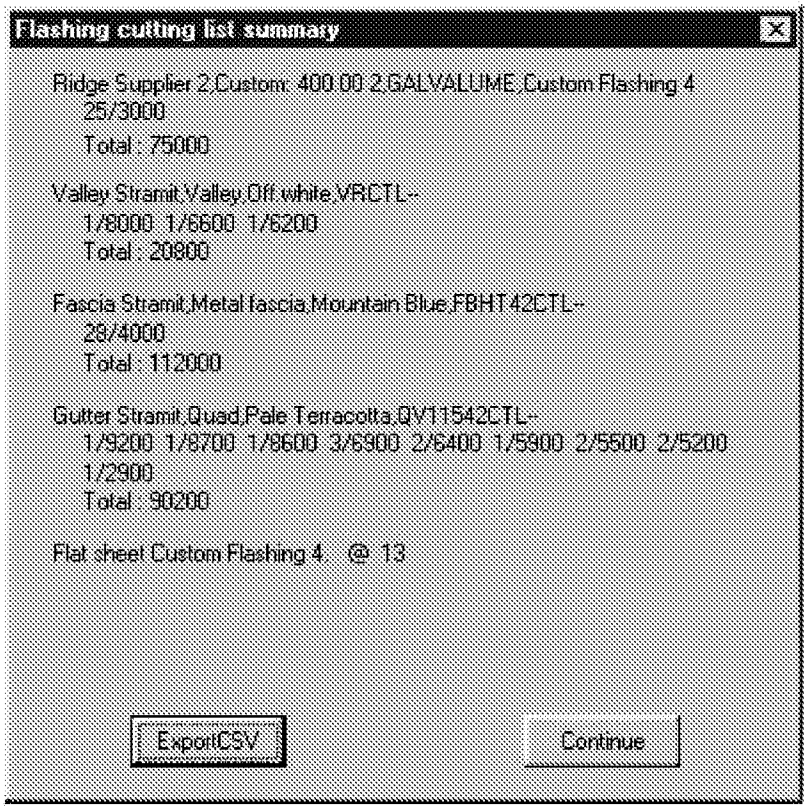
Clicking this button lets you set a user defined allowance to a particular run. For example, you may want to add extra allowances for valleys around dormers.

After you click Single-Allow, you enter the allowance you want to add, then select the line you want to add the allowance to. When the flashings for this run are quantified, the run length will then become, the actual length of the line plus the allowance.

When you click Cancel the flashing dialog box is displayed and changes you made to the allowances are discarded.
When you click Ok, the flashing dialog box is displayed and changes you made to the allowances are retained.

Generate
This command generates a flashing cutting list for this job depending on the estimation you have set for each flashing type. If you have selected an estimation method which deals with each run individually, the cutting list for that run is automatically annotated on the drawing.

When you click this command, the flashing list is displayed on the Flashing cutting list summary dialog box.



Here you see the cutting list for each flashing type, as well as the number of flat sheets for the custom flashing.
If you want to export this flashing list to a comma separated value file (.csv) for import into another computer system, click **ExportCSV**.

> Remember : to accurately report the flashings in the costing summary, you must generate the flashings first.

Click Continue to return to the flashing dialog box.

Delete
This will delete the flashing cutting list you have generated. The cutting list annotations in the model are also deleted.

View-List
This command displays the previous flashing list you generated.

Single-Line

This command allows you to assign a roof line any flashing material you like. This will override the global flashing setting for that particular line and be tallied accordingly.

After you select the command, you first select the individual line, then select the flashing material. No check is made to ensure that you assign a logical flashing type. That is, here you can easily assign a ridge with a valley flashing for instance.

Set as default
This command sets the currently selected flashing types as default for all further jobs.

Set Color
To quickly set the color for each of the Colored flashings, click **Set Color**. Then select the color you want.

Close the dialog box by clicking Ok.

Sarking

The sarking command lets you apply and remove sarking from the roof. When you select **Sarking**, the roof panels in the job are displayed with a hatch pattern.

The following submenu is displayed.

Apply	This command lets you select one or more panels to apply sarking to
Remove	This command lets you remove sarking from one or more roof panels.
Apply-All	This command automatically applies sarking to all roof panels in the job
Remove-All	This command removes sarking from all panels on the job.
Verify	This command reports whether a selected panel has sarking or not.

You assign the sarking roll size and sarking cost in the Costing Costing-rates dialog box.

Insulation

This command allows you to assign insulation and sarking to the entire roof or simply to parts of the roof. You can even assign areas which have no insulation. When you click this command, a sub-menu is displayed.

Select-default
This option allows you to set the insulation and sarking for the entire roof. When you first click this command, the Insulation list states there is no insulation selected.

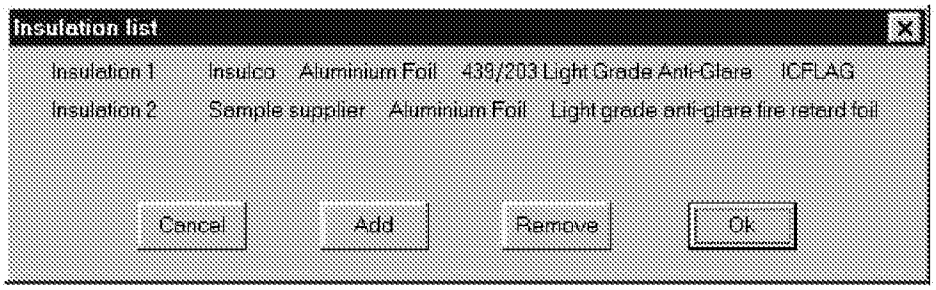


When you click **Add**, the list of insulation types is displayed. You do this for each of the insulations you want.

You can select up to 20 different insulations. To remove the default insulation covers, click **Remove**. This resets the list to being empty.

When you click **Ok**, the list you have selected applies to all planes in the job.

After you have selected two insulation covers, the list would look similar to that below.



Apply-to- Plane
This command allows you to apply insulation to a single plane, independent of the global settings. You first select all the planes you want to change, then build the list of insulation coverings you want. Those insulation settings are then stored with that plane.

Remove
This option allows you to have no insulation applied to the selected plane. First you select one or more planes. When you accept the selection, those planes will be marked as having no insulation.

Reset-Plane
This command allows you to reset all the planes in the job to adopt the global insulation list. That is, it removes any user defined changes you have made.

Negative-plane
Here you can insert a negative sarking area. After you digitize points defining the extent of the area, a plane is inserted. When the total amount of sarking is tallied later on, this area will be subtracted from the plane area to leave a nett sarking area. You can select the type of sarking for this negative area the same way you do for a standard plane.

Verify
This command displays in a dialog box, the sarking associated with a plane you select. It also notes if the plane is actually a negative area.

Downpipes

This command displays a submenu which allows you to select and draw downpipes.

A downpipe is simply a 2D dot drawn on the line you select. When all the materials for the job are tallied later on, each downpipe will spawn lengths of pipe, a pop, offsets, and possibly an elbow or a shoe.

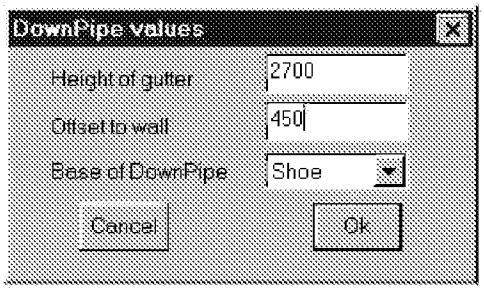
When you first click this command, the list of available downpipes is listed. This selection then becomes the type of downpipe for all the downpipes in the model. You can mask the display of downpipes if you with the **Utilities Set-Display** command.

Select
This command allows you to change the type of downpipe you want for this job.

Insert
This command allows you to draw a downpipe.

After you click Insert, you are prompted to locate a line onto which the downpipe is inserted. Typically, you would select a fascia line. A downpipe is drawn on the line you selected.

Then the Downpipe values dialog box is displayed. This dialog allows you to set parameters for the downpipe.



Height of gutter This is the height of the gutter. The default value is the height of the gutter above zero. You would enter a suitable value here so the costing section can resolve the number of fixed length pieces of downpipe are required for this job.

Offset to wall This is the offset distance to the wall so the system can determine the type off offset piece to use. The default value is the horizontal distance to the closest wall. If it is zero, a wall was not found close by.

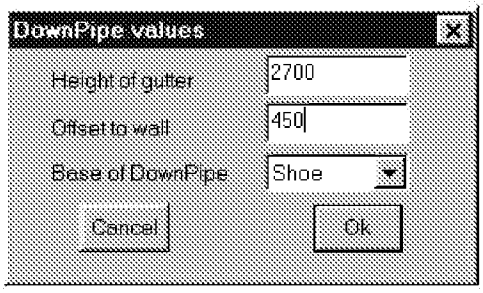
Base of downpipe This is a drop down list where you can assign the base piece of the downpipe to be nothing, an elbow or a shoe.

After you click **Ok**, the downpipe is inserted.

Change
Here, you can change an existing downpipe.

After you select the downpipe in the model, the Downpipe values dialog box is displayed.

The values in the dialog box are those you first inserted the downpipe with. After you make the



changes, click **Ok** to make them permanent.

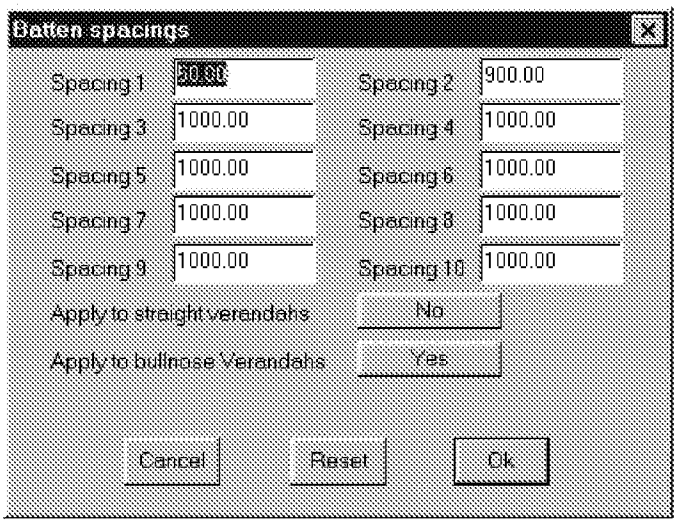
Delete
This command allows you to delete downpipes in the model. After you click **Delete**, you then select the downpipes to delete.

Battens

This command allows you to draw battens on the roof.

Battens are simply lines which are cut onto the roof based on spacings you set.

After you click this command any battens in the job are first deleted, then the Batten Spacing dialog box is displayed.

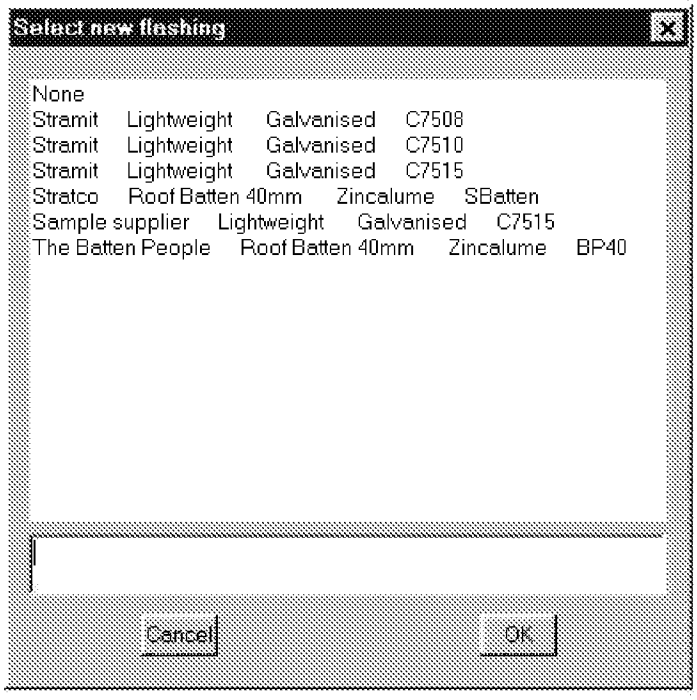


This dialog allows you define the spacings between each batten row, as well as determining if you want battens generated on bullnose and straight verandahs.

Spacing (n)	This is the distance from the previous batten measured up the roof plane. For the first spacing, it is the distance from the fascia up the roof plane.
Apply to straight verandahs	This is a toggle to determine if you want battens drawn on straight verandahs in this job.
Apply to straight verandahs	This is a toggle to determine if you want battens drawn on bullnose verandahs in this job.

The **Reset** button helps you set all the spacings to the one value.

When you click **Ok**, you then select the type of batten you want to use from the Select new flashing list box.



After clicking **Ok** to the batten selection, battens are generated on all the roof planes (and perhaps the verandahs too).

User-Lengths

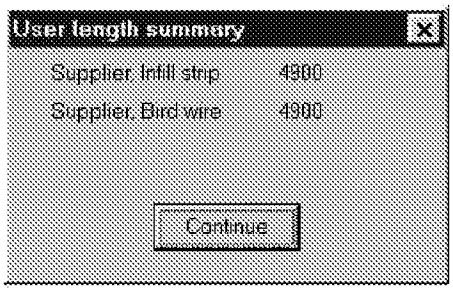
This command allows you to add user defined items to lines in the model. Lines which have a user length attached are added to the cost summary and labor rates automatically. When you select **User-Lengths**, a submenu is displayed..

Add

After you select an item from the list, select one or more lines to attach the item to.

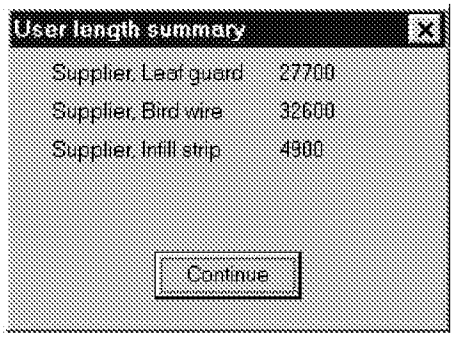
Verify

This command lets you select a line and see if a user length has been assigned to it.



Tally

This command tallies the overall lengths of the user items in the job and displays them in a dialog box.



Delete

This command deletes the user length item from the lines you select.

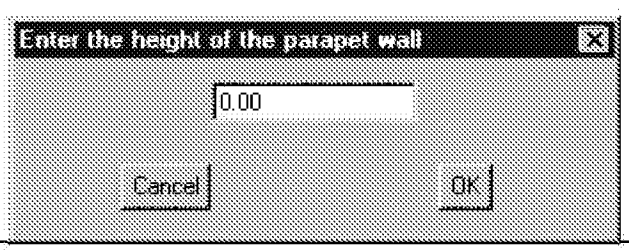
You can create a user length item in *flashing.dat*.

Edge-Assemblies

This command displays a submenu which allows you to assign and tally edge assemblies for Low-Slope roofs.

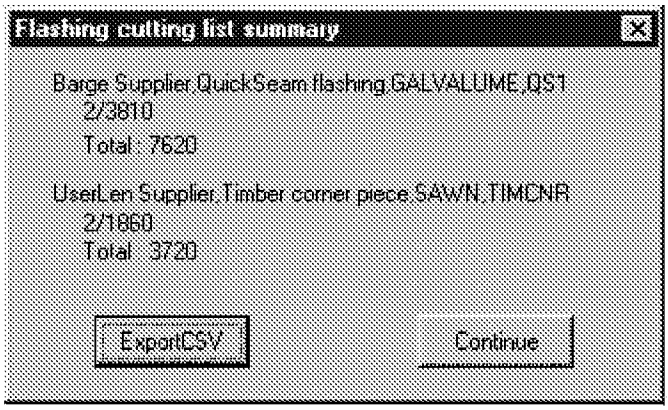
Set

This command lets you assign an assembly to an edge.
You are first prompted to select the lines to assign the assembly.
Then, you are prompted to enter the height of the parapet wall along this edge. If there isn't one, then



enter zero.

Tally
This command tallies the edge assembly flashings you have in the job and lists them on-screen.



Delete
This command deletes the edge assembly flashings from lines you select.

Fixtures

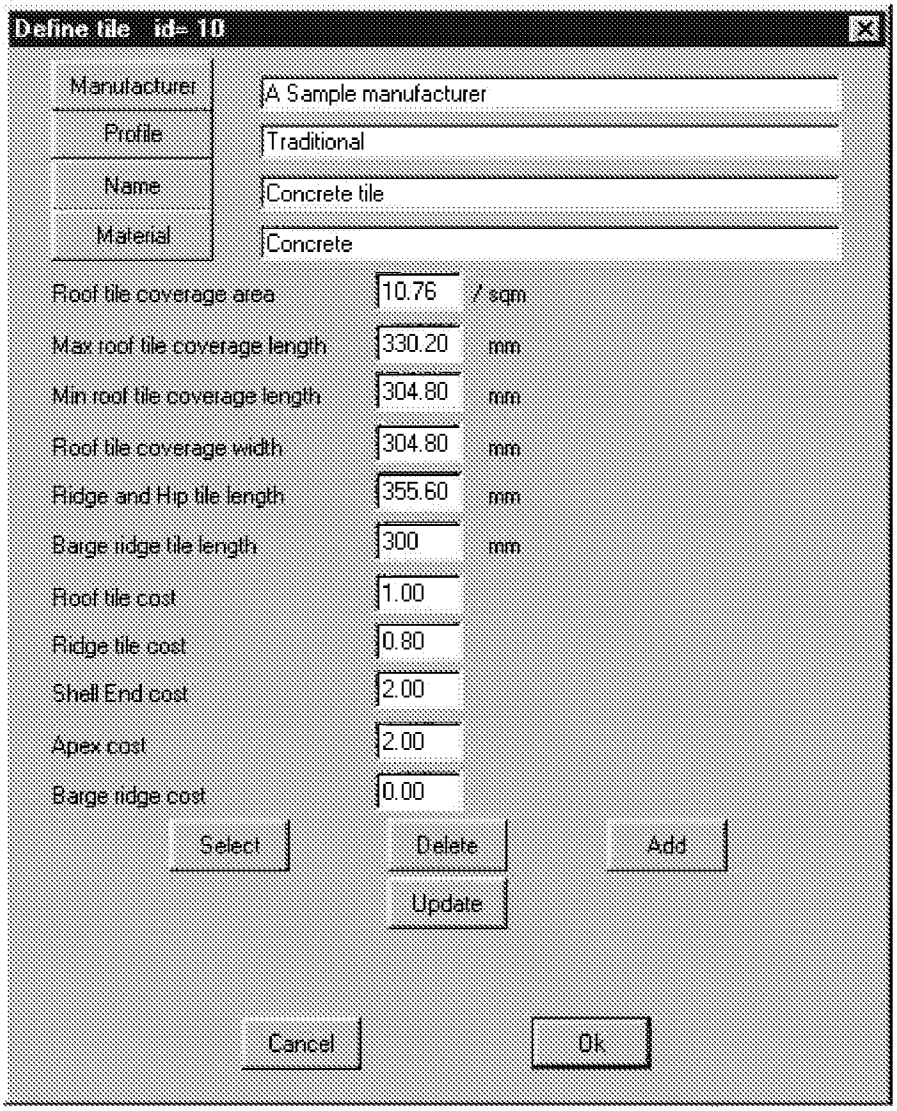
This command displays the list of fixtures you have already defined with the **Cover Define Materials Fixtures** command. Depending on the insertion method for the selected fixture, you are prompted to select a single point, 2 points or a line. When you have done that, the graphic figure of the fixture is inserted.
To generate the flashings list from these fixtures you must perform the **Cover Flashing Generate** command. The flashings derived from these fixtures are then accumulated with the other flashings in the job.
The no off of the fixtures is automatically tallied when you perform a costing. Refer to **Cover Define-Materials Fixtures** to see how you define a fixture.

Define-Materials

This command allows you to add, delete and change material definitions directly (ie without needing to edit the data files in a text editor).

Tiles

Here you can define a new tile in the database. After selecting define, the Define Tile dialog box is displayed



The dialog box lets you enter textual information about the tile as well as geometric values. The textual information is used to select the tile later on. The geometric values determine how many of these tiles are to be used for the job.

Manufacturer This is the manufacturer of the tile. You can enter any name you wish, or if you click the **Manufacturer** button, you can select the name from a list. The list is derived from all the manufacturer names already in the database.

Profile This is the profile of the tile. You can enter any name you wish, or if you click the **Profile** button, you can select the name from a list. The list is derived from all the profile names already in the database.

Name This is the name of the tile. You can enter any name you wish, or if you click the **Name** button, you can select the name from a list. The list is derived from all the names already in the database.

Material This is the material of the tile. You can enter any name you wish, or if you click the **Material** button, you can select the name from a list. The list is derived from all the material names already in the database. If the tile material is Concrete, then the concrete pay rates are used; if its not concrete, then the terracotta pay rates are used.

Roof tile coverage area This is the number of tiles per square meter. This value is used if you choose to do the estimate by the area method later on.

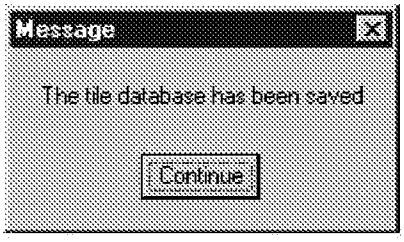
Max roof tile coverage length This is the maximum length of coverage for this tile. This value is used later on in the Coursing commands to determine the course layout.

Min roof tile coverage length This is the minimum length of coverage for this tile. This value

	is used later on in the Coursing commands to determine the course layout.
Roof tile coverage width	This is the coverage width of the tile. It is used to determine the number of tiles when you use the coursing method.
Ridge and hip tile length	This is the length of the ridge tile. It us used later on when you do the estimate to determine the number of ridge tiles. If this value is zero, then the **Ridge Cover length** value from the **Costing Cover-rates** dialog is used instead.
Barge ridge tile length	This is the length of the barge ridge tile.
Roof tile cost	The cost of a single roof tile.
Ridge tile cost	The cost of a single ridge tile.
Shell end tile cost	The cost of a single shell-end tile.
Apex tile cost	The cost of a single apex tile.
Barge tile cost	The cost of a single barge tile.

If you click **Select**, you can select an existing tile from the database to be used as a template to define a new tile or for you to update its values. After you select a tile, an **Update** button appears so you can update the definition of this tile.
If you click **Delete**, the currently selected tile is deleted from the database.
If you click **Add**, the tile is added to the database.

When you click **OK**, you are informed that the changes you have made are saved.



The tile definitions are saved into *tiles.bin*.

Shingles

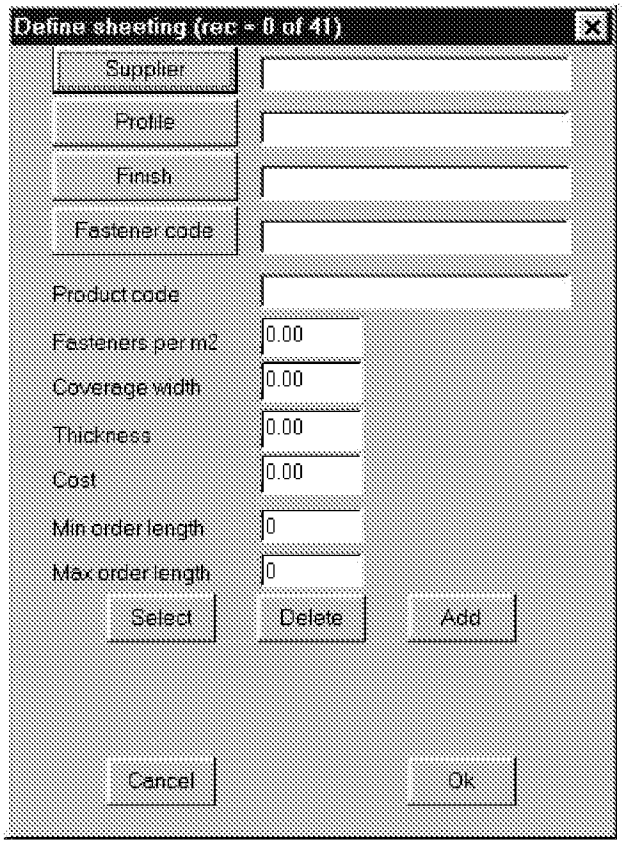
Here you can define a new shingle in the database. After selecting define, the Define Shingle dialog box is displayed. For a complete explanation, refer to the **Define-Materials Tiles** command above. The operation for shingles is exactly the same. For shingles however, you can define the quantity based on pieces or bundles. If you are in imperial units, you can set the coverage as per foot or per square.
The shingle definitions are saved into *shingles.bin*.

Shakes

Here you can define a new shake in the database. After selecting define, the Define Shake dialog box is displayed. For a complete explanation, refer to the **Define-Materials Tiles** command above. The operation for shakes is exactly the same. For shakes however, you can define the quantity based on pieces or bundles. If you are in imperial units, you can set the coverage as per foot or per square.

The shake definitions are saved into *shakes.bin*.

Metal-Panels



Supplier This button lists all the suppliers in the sheeting database from which you can select one. You can also enter a new supplier name directly into the supplier field.

Profile This button lists all the profiles in the sheeting database from which you can select one. You can also enter a new profile directly into the profile field.

Finish This button lists all the finishes in the sheeting database from which you can select one. You can also enter a new finish directly into the finish field.

Fastener code This button lists all the fasteners in the fastener database from which you can select one. You can also enter a new fastener directly into the fastener field.

Product code Here you can enter a product code for ordering purposes.

Fasteners per m2 The number of fasteners per square meter for estimation purposes

Coverage width The exposure of the sheet

Thickness The thickness of the sheet

Cost The cost per square meter of the material

Min order length The minimum length you can order

Max order length The maximum length you can order

Select This button lists all the sheets in the database from which you can select one to view, edit or delete

Delete This button deletes the current definition

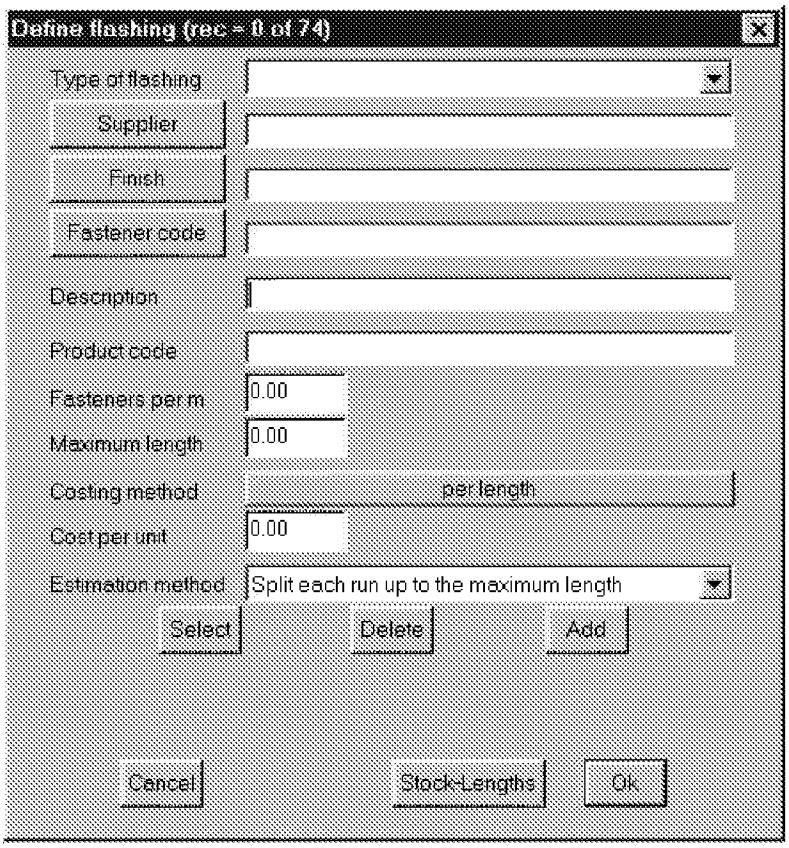
Add This button adds the current definition to the database as long as it is unique

Update This button appears only after you have selected Select. This button then updates the current record with the current details

Cancel Does not make the changes permanent.

Ok Makes all the changes permanent

Flashings



Type of flashing This is a drop down list letting you select one of Ridge, Valley, Fascia, Gutter, Barge, Apron, Batten, Box gutter, User-defined and Step.

Supplier This button lists all the suppliers in the flashings database from which you can select one. You can also enter a new supplier name directly into the supplier field.

Finish This button lists all the finishes in the flashings database from which you can select one. You can also enter a new finish directly into the finish field.

Fastener code This button lists all the fasteners in the fastener database from which you can select one. You can also enter a new fastener directly into the fastener field.

Description A user defined description of this flashing from which you identify this flashing

Product code Here you can enter a product code for ordering purposes.

Fasteners per m The number of fasteners per meter for estimation purposes

Maximum length The maximum length of this flashing you can order (or 0 if there is no maximum)

Cost method This is either per meter or per length.

Cost per unit This is the cost per unit based on the above setting.

Estimation method This is the manner by which Roof Wizard is to estimate the number of lengths of this flashing. (See below)

Select This allows you to select an existing flashing from a list

Delete This allows you to delete the current flashing

Add This allows you to add a new flashing definition as long as it is unique

Accessories This allows you to associate accessories to the current flashing. This button will only appear for Barge, Fascia and Gutter flashings. (See below)

Stock-Lengths This allows you to associate a list of stock lengths and costs to the current flashing. (See below)

Cancel	This button cancels all changes you have made
Ok	This button saves the changes you have made.

Flashing Estimation Methods

The estimation method is one of

Split each run up to the maximum length – this method measures each run and divides it into a number of equal length pieces which do not exceed the maximum length. Allowances are also taken into account.

Split each run into maximum length pieces – this method measures each run, then supplies enough maximum length pieces to cover the run. Allowances are also taken into account.

Split total run length into maximum length pieces – this method adds all runs of this flashing, then supplies enough maximum length pieces to cover the entire length.

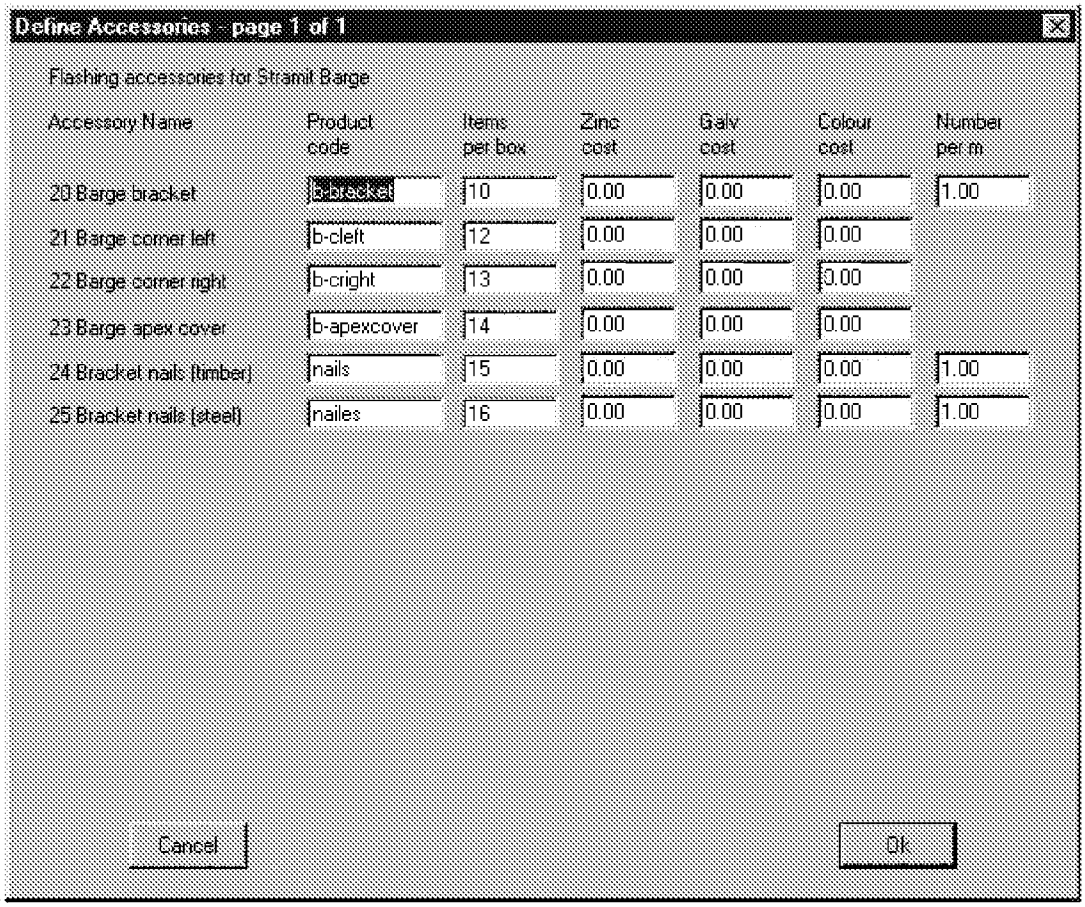
Split each run into stock length pieces – this method measure each run, then looks at the stock lengths you have defined for this flashing. It then supplies a combination of stock length pieces to cover this run taking allowances into account.

Accessories

This dialog box displays the list of possible accessories you can associate with a flashing. Note that the list of items for barges, fascias and gutters is different.

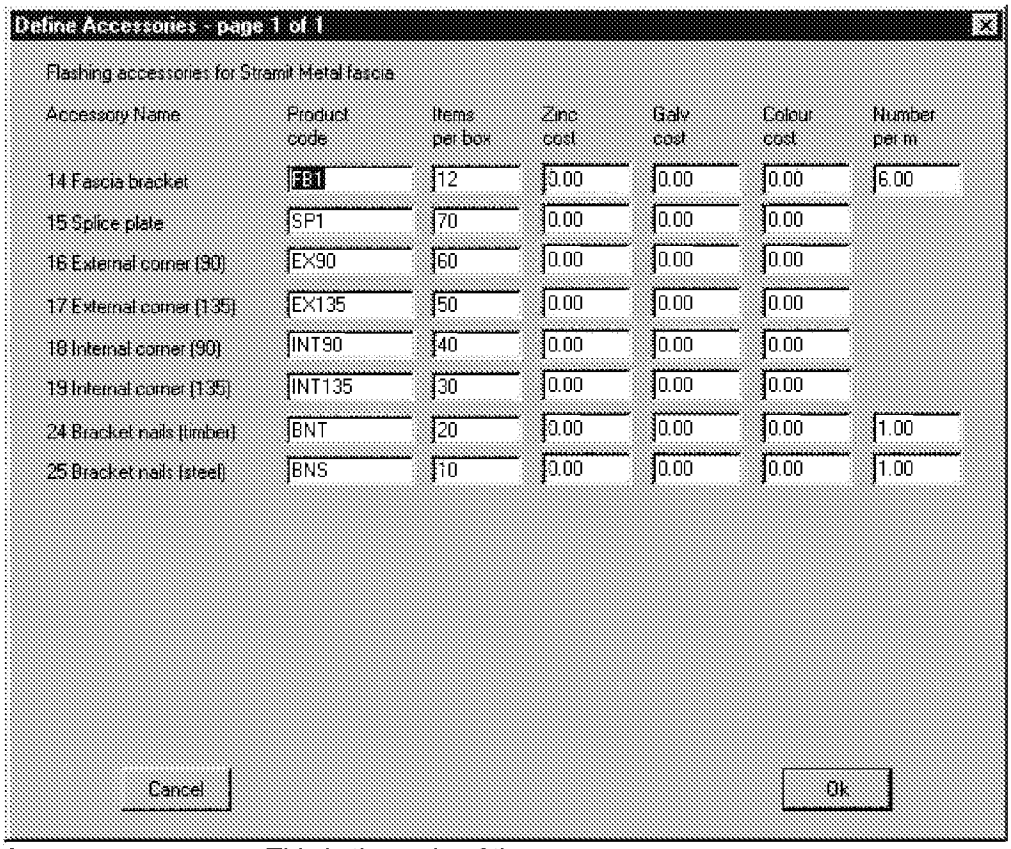
Each dialog box lets you enter a product code, items per box and costs for zinc, galvanized and colorbond materials. If you do not want an accessory to be associated with the flashing, then enter 0 as the number of items.

For a barge flashing you get the following dialog box



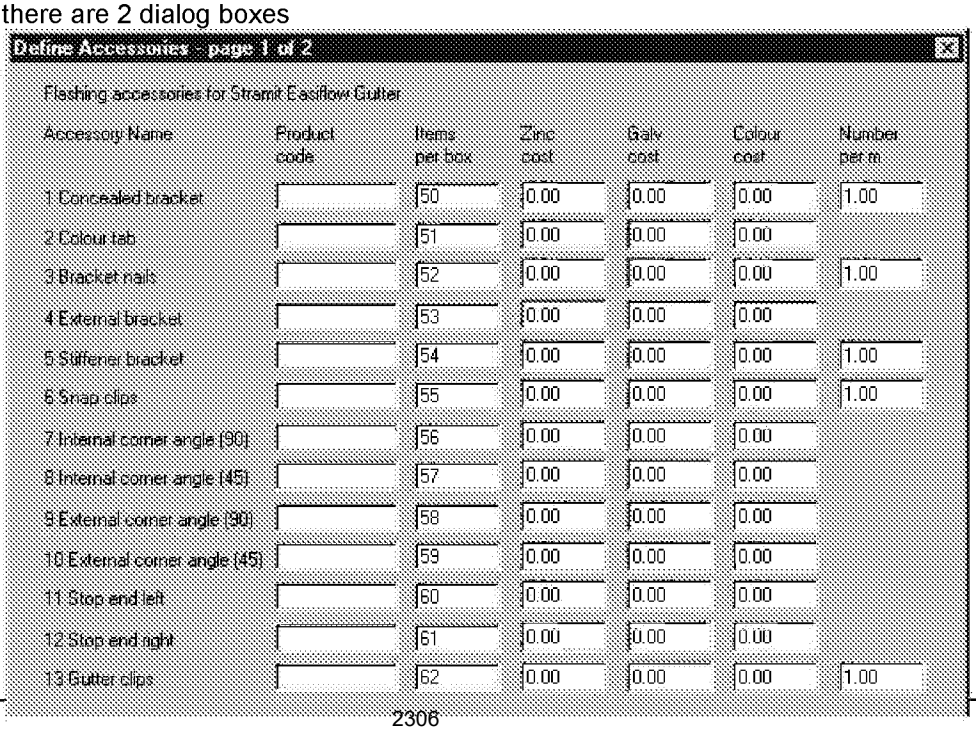
Code	This is the code of the accessory
Items	This is the number of items per cost unit (eg you may have 100 nails per box)
Zinc	The cost of zincalume material
Galv	The cost of the galvanized material
Color	The cost of the colorbond material
Number per m	This is the number of items per meter

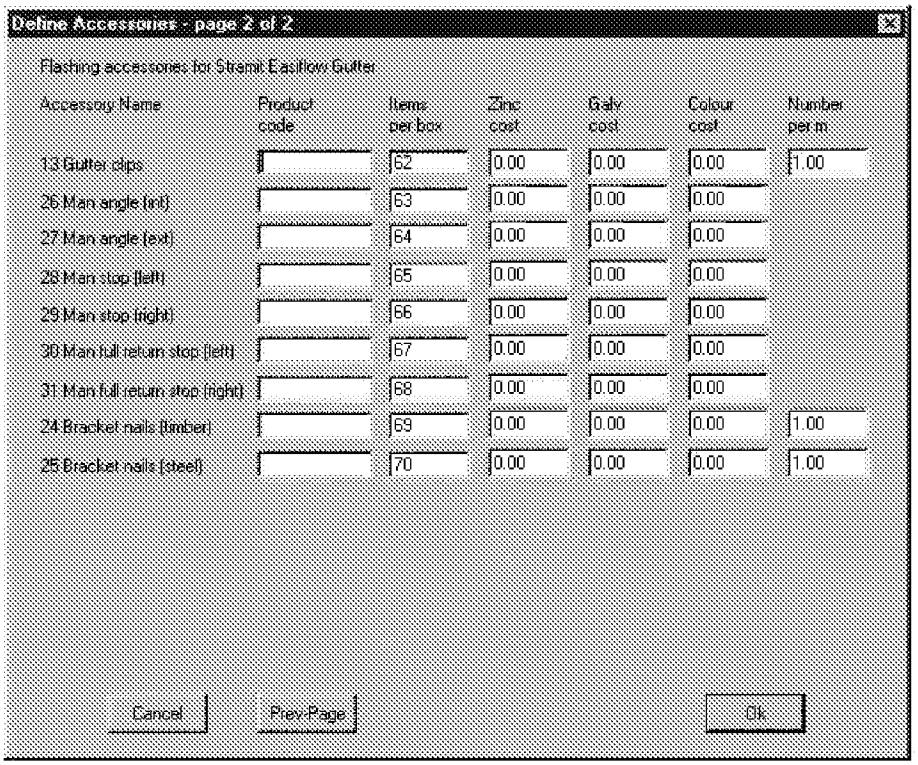
For a fascia flashing you get the following dialog box



Code	This is the code of the accessory
Items	This is the number of items per cost unit (eg you may have 100 nails per box)
Zinc	The cost of zincalume material
Galv	The cost of the galvanized material
Color	The cost of the colorbond material
Number per m	This is the number of items per meter

For a gutter, there are 2 dialog boxes

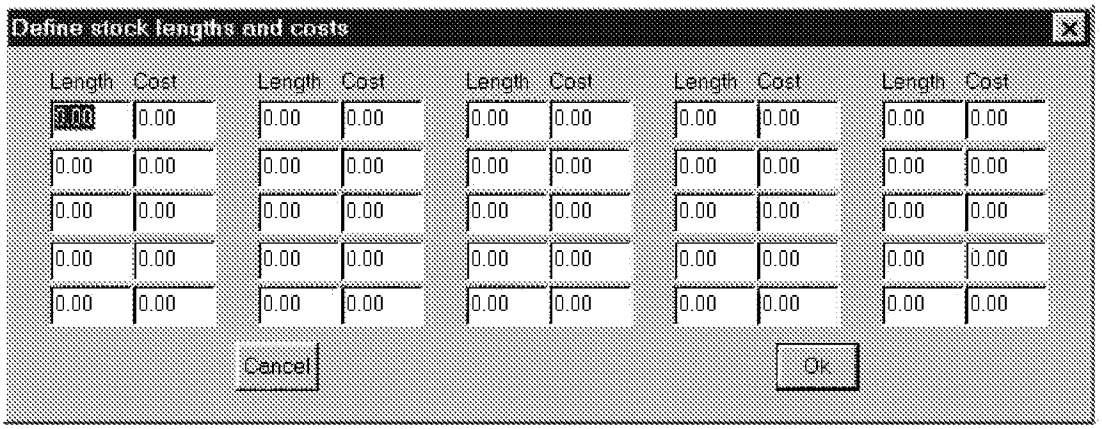




Code	This is the code of the accessory
Items	This is the number of items per cost unit (eg you may have 100 nails per box)
Zinc	The cost of zincalume material
Galv	The cost of the galvanized material
Color	The cost of the colorbond material
Number per m	This is the number of items per meter

Stock-Lengths

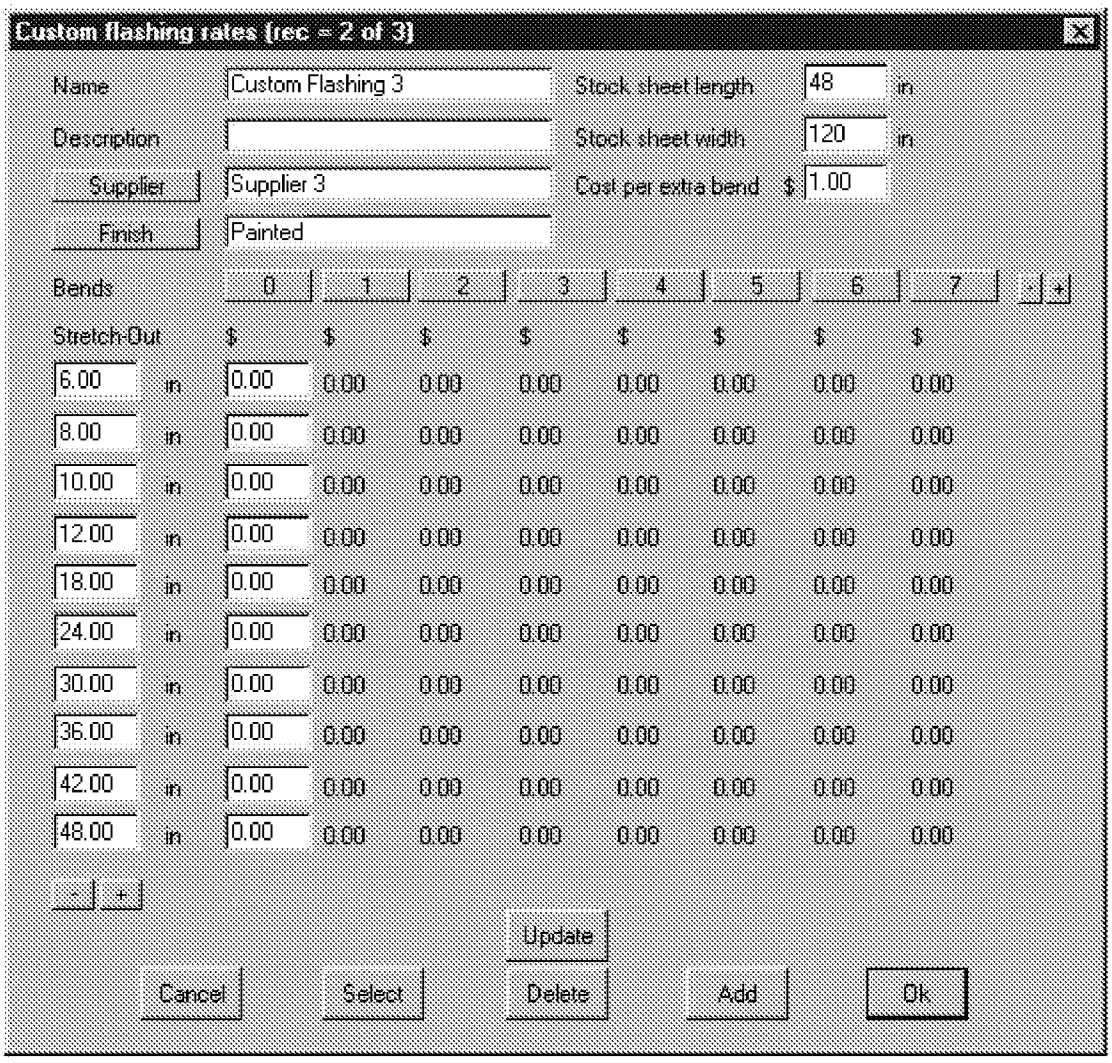
This button displays a dialog letting you enter lengths and costs of stock lengths for this flashing.



Here you enter a stock length, followed by a cost for that length. You can have up to 25 lengths. You do not need to worry about order or the cell you use to enter the length and cost pair.
Note that these lengths will only be used if you have selected the *Split each run into stock length pieces* estimation method. The costs are only used if you selected *per length* as the costing method.

Custom-Flashing

This command allows you to set up custom flashing fabrication costs.

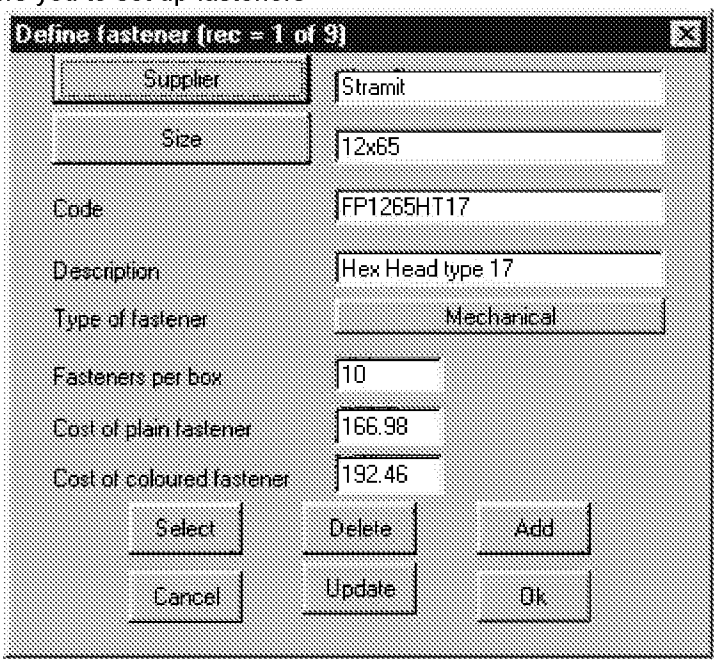


Name The name you want to refer to this custom flashing table

Description	A user defined description
Supplier	The supplier of this custom flashing table
Finish	The finish of this material (Painted, color, galvalume, zinc)
Stock sheet length	The length of the flat stock sheet
Stock sheet width	The width of the flat stock sheet
Cost per extra bend	The cost per bend, in excess of the number of bends you have defined.
Bends	These buttons relate to the cost to fabricate a piece with this number of bends. To “open” a column for edit, click on the relevant bend button.
Girths/Stretch-out	This is the list of girths in this table. You simply enter the girth in the relevant field.
+/-	These buttons allow you to remove and add an extra bend and girth.
Select	This button lets you select and existing custom flashing table.
Delete	This button lets you delete the current custom flashing table.
Add	This button lets you add the current table as a new custom flashing table.
Update	This button lets you update an existing custom flashing table.
Cancel	This button lets you Cancel from this dialog box.
Ok	This button lets you save the changes you have made.

Fasteners

This command allows you to set up fasteners

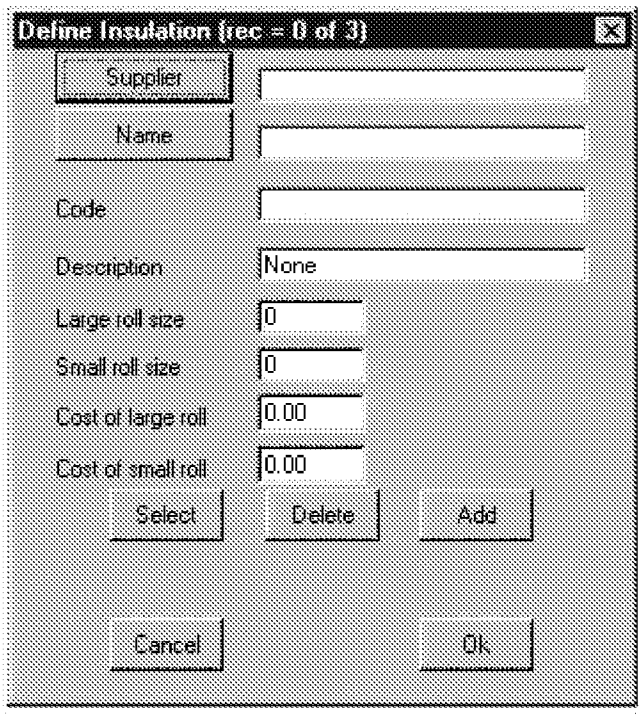


Supplier	This button lists all the suppliers in the fastener database from which you can select one. You can also enter a new supplier name directly into the supplier field.
Size	This button lists all the sizes in the fastener database from which you can select one. You can also enter a new size directly into the finish field.
Code	This is the fastener code which you use to link to sheeting and flashings.
Description	This is a free form description for you to select fasteners
Type of fastener	This is either mechanical or liguid.
Fasteners per box	The number of fasteners per box
Cost of plain fasteners	The cost of a box of plain fasteners
Cost of colored fasteners	The cost of a box of colored fasteners

Select	This button lists all the fasteners in the database from which you can select one to view, edit or delete
Delete	This button deletes the current definition
Add	This button adds the current definition to the database as long as it is unique
Update	This button appears only after you have selected Select. This button then updates the current record with the current details
Cancel	This button cancels all changes you have made
Ok	This button saves the changes you have made.

Insulation

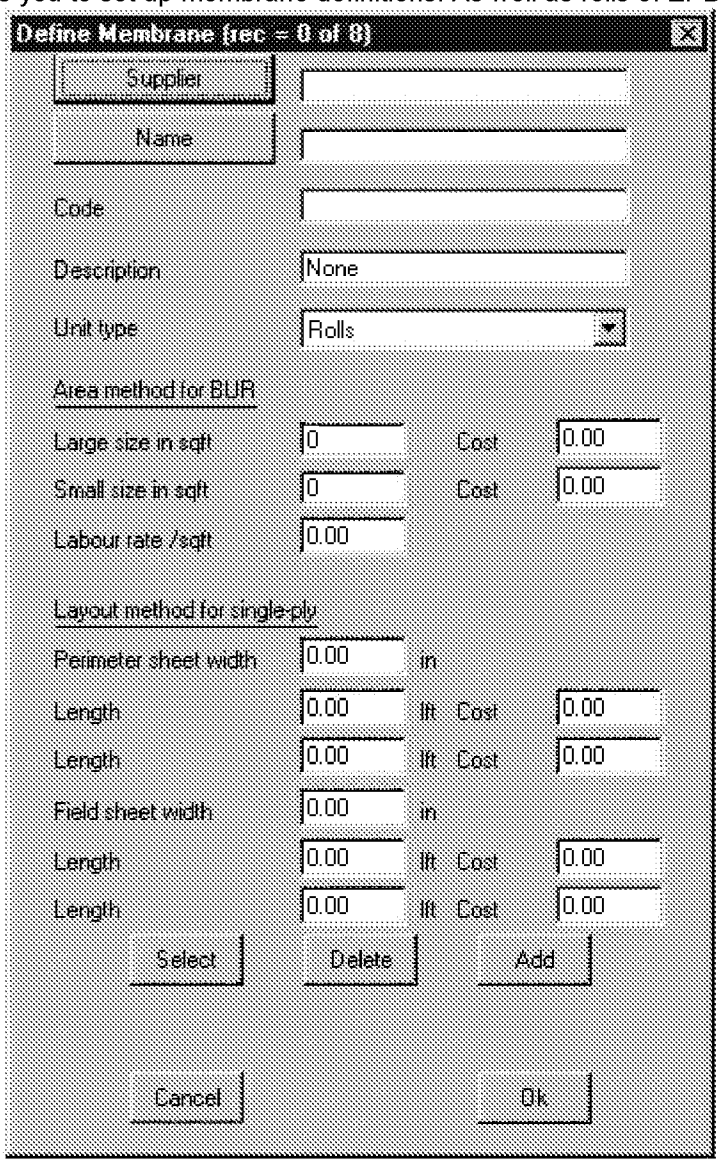
This command allows you to set up insulation.



Supplier	This button lists all the suppliers in the insulation database from which you can select one. You can also enter a new supplier name directly into the supplier field.
Name	This button lists names fields in the insulation database from which you can select one. You can also enter a new name directly into the name field.
Code	This is the insulation product code.
Description	This is a free form description for you to select insulation
Large roll size	The size of a large roll of insulation
Small roll size	The size of a small roll of insulation
Cost of large roll	The cost of a large roll of insulation
Cost of small roll	The cost of a large roll of insulation
Select	This button lists all the insulation records in the database from which you can select one to view, edit or delete
Delete	This button deletes the current definition
Add	This button adds the current definition to the database as long as it is unique
Update	This button appears only after you have selected Select. This button then updates the current record with the current details
Cancel	This button cancels all changes you have made
Ok	This button saves the changes you have made.

Membrane

This command allows you to set up membrane definitions. As well as rolls of EPDM and



reinforcement felt, you would define adhesives as a membrane too.

Supplier This button lists all the suppliers in the membrane database from which you can select one. You can also enter a new supplier name directly into the supplier field.

Name This button lists names fields in the membrane database from which you can select one. You can also enter a new name directly into the name field.

Code This is the membrane product code.

Description This is a free form description for you to select insulation

Unit type	This is one of rolls, sheets or drums

For BUR roofing systems, the following values are used for the estimation.

Large size	The coverage of the large size
Small size	The coverage of the small size
Cost of large size	The cost of the large size
Cost of small size	The cost of the small size

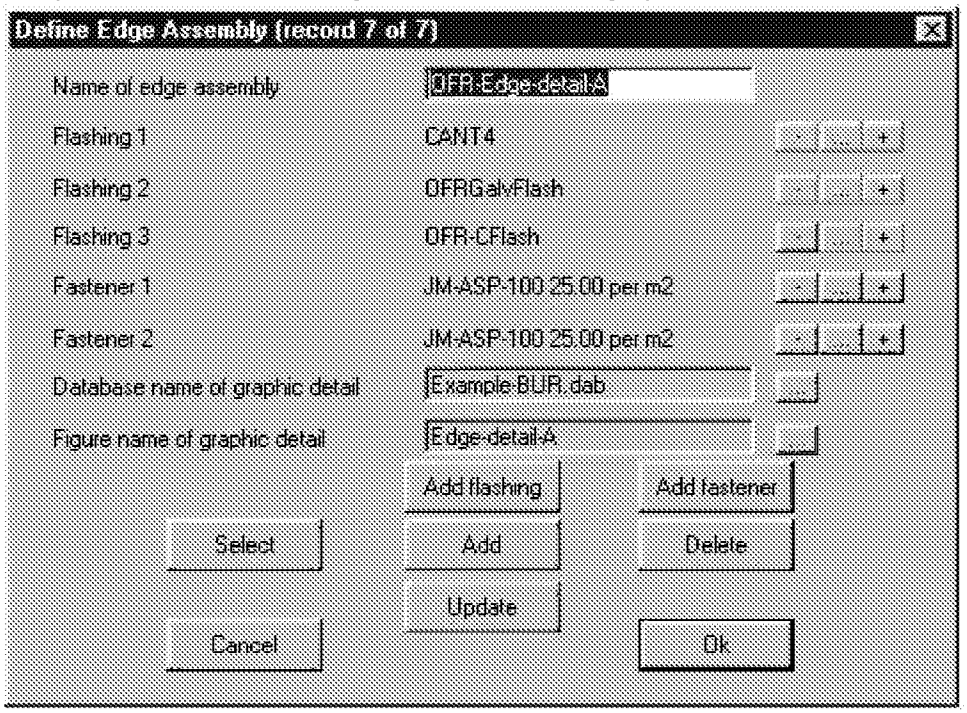
For single-ply roofing systems, the following values are used for the estimation and layout.

Perimeter sheet width	The width of the perimeter sheet
Length	The length of a long roll
Length	The length of a short roll
Cost	The cost of a long roll
Cost	The cost of a short roll
Field sheet width	The width of the field sheet
Length	The length of a long roll
Length	The length of a short roll
Cost	The cost of a long roll
Cost	The cost of a short roll

Select	This button lists all the membrane records in the database from which you can select one to view, edit or delete
Delete	This button deletes the current definition
Add	This button adds the current definition to the database as long as it is unique
Update	This button appears only after you have selected Select. This button then updates the current record with the current details
Cancel	This button cancels all changes you have made
Ok	This button saves the changes you have made.

Edge-Assembly

This command allows you to set up Low-Slope-roof edge assembly definitions. These definitions comprise one or more flashings as well as a detail graphic.



Name of edge assembly	This is the name you define for this edge assembly. You will use this name later when selecting edge assemblies.

Database name of graphic detail	This is the name of the database (.dab file) containing the subfigure of the graphic detail (the next field). When you click this field, you can select the database you want. The default database name is *RoofMaestro.dab*.
Figure name of graphic detail	This is the name of the subfigure to be inserted when you select this edge assembly. When you click this field, the list of subfigures in the given database name are listed. From this list, you select the one you want.
Add-Flashing	This allows you to add a flashing to the list of flashings which define this edge assembly
Add-fastener	This allows you to add a fastener to the list.
Select	This allows you to select an existing edge-assembly definition.
Add	This allows you to add a new edge-assembly definition.
Delete	This allows you to delete an existing edge-assembly definition.
Update	This allows you to update an existing edge-assembly definition.

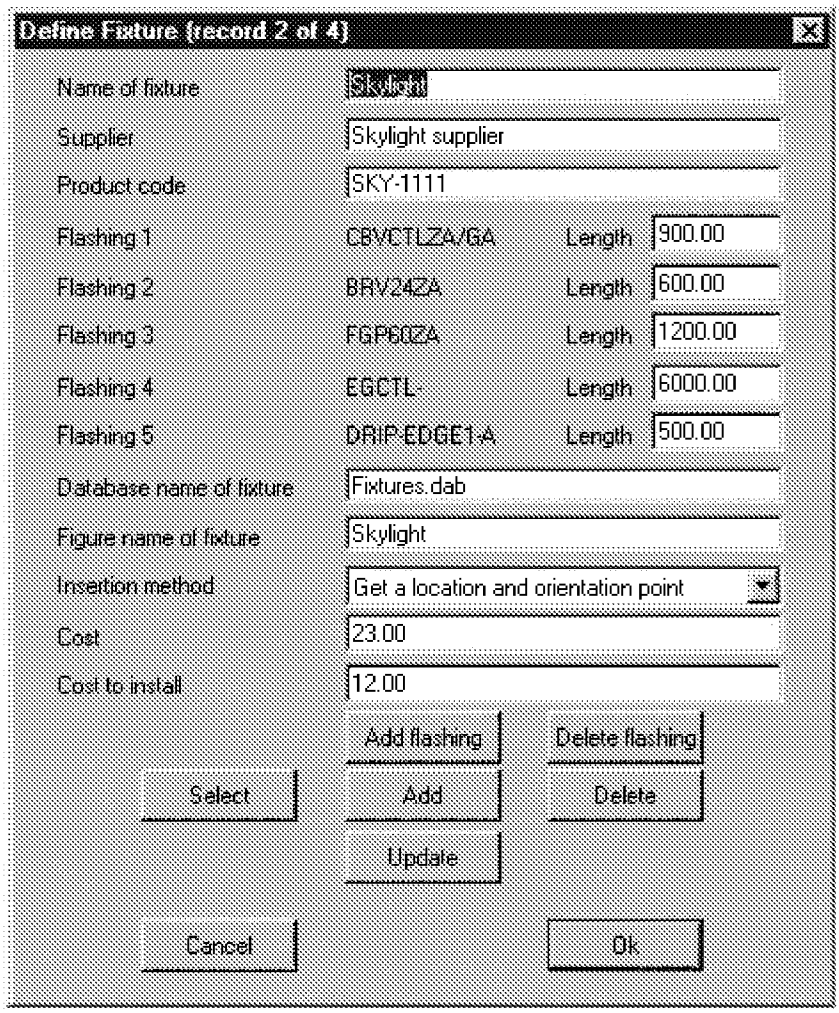
The buttons to the right of each line item are

- \- Delete this item
- … Change this item
- \+ insert an item before this one

Fixture

This command lets you define a new fixture or edit an existing one. You would use this command to draw and quantify such objects as skylights, ventilators, drains, downpipe pops etc. for the job.

When you select this command, the Define Fixture dialog box is displayed.



Name of fixture This is the name you define for this fixture. You will use this name later when selecting fixtures.

Supplier The name of the fixture supplier

Product code The code of this fixture.

Flashing The code of the first flashing associated with this fixture.

Length The length of this flashing required for this fixture.

There are repeated Flashing and length fields; one for each flashing

Database name of fixture This is the name of the database (.dab file) containing the subfigure of the graphic detail (the next field). When you click this field, you can select the database you want. The default database name is *Fixtures.dab*.

Figure name of fixture This is the name of the subfigure to be inserted when you select this fixture. When you click this field, the list of subfigures in the given database name are listed. From this list, you select the one you want.

Insertion method This is one of Get a location and orientation point (such as a rectangular skylight), Get a location point only (such as a round drain), Insert along a line entity (such as a pop)

Cost The cost of this fixture

Cost to install The cost to install this fixture

Add-Flashing This allows you to add a flashing to the list of flashings which you want associated with this fixture

Delete-Flashing This allows you to remove a flashing form the flashing list.

Select This allows you to select an existing fixture.

Add	This allows you to add a new fixture.
Delete	This allows you to delete an existing fixture.
Update	This allows you to update an existing fixture.

To save your definitions you must click **Ok**, The definitions are saved in *Fixtures.dab* regardless of where the subfigures reside.

Estimate

The estimate set of commands provides you with the tools to estimate metal panels on a roof. It is assumed of course, that you have already modeled a roof.

The estimation process involves two basic steps
1. Setting the allowances, such a gutter overhang etc
2. Determining the sheet estimation method you wish to use and then applying it

This will then result in a panel list.

Commands are also provided to draw lap-direction arrows

The sheet estimation methods

There are five sheet estimation methods provided. These methods are called
1. The blocking method
2. Generating offcuts
3. Tallying panels
4. Matching panels
5. Linear nesting

You would choose the estimation method based on the profile of the sheeting material as well as your on-site installation process.

The blocking method

This method creates rectangular blocks on the roof geometry. This would be familiar to many estimators as it replicates the traditional estimation method for corrugated iron sheeting. This method assumes the material profile is symmetric which means that offcut pieces may be used elsewhere in the job. Even though, rectangular blocks are generated from the roof geometry, no explicit statements are made about the positioning of individual sheets. The final sheet laying and positioning is left up to the installer.

Here the number of different sheet lengths is a function of the ridge to gutter lengths.

Generating offcuts

This method generates a sheet list by dividing the roof geometry into rectangles and triangles. Rectangular areas represent the straight sheeting whereas triangular areas represent cut of offcut pieces. Each triangular area is labeled as a C (cut area) or as O (an offcut area). The idea being that offcuts from cut area 2 (C2) go to offcut area 2 (O2). There may also be rhomboidal shapes which end up being stripped into individual sheets. These are annotated as St.

This method however creates a larger list of different sheet lengths compared to the blocking method.

Tallying panels

This method generates sheets on each separate roof plane. It also assumes the profile is non-symmetric and offcuts will not be used. Similar length sheets are combined, but this method generally results in a large number of sheet lengths.

> Prior to creating a costing for sheeting and flashing you must tally the roof cover and tally the flashings. If you don't, then they will not be reported in the costing. Worse still, it may report a previous tally for this job.

Matching-Panels

The panel matching process is dependent not only on the geometric end shape, but also, the lap direction of the matching panel. If the lap direction of a geometrically matching panel is not defined, then the lap direction is inherited from the initial panel. Also, all panels on that particular roof plane have their lap direction defined also. If the lap direction is defined for the matching panel, then it is used to determine whether the match is suitable or not.

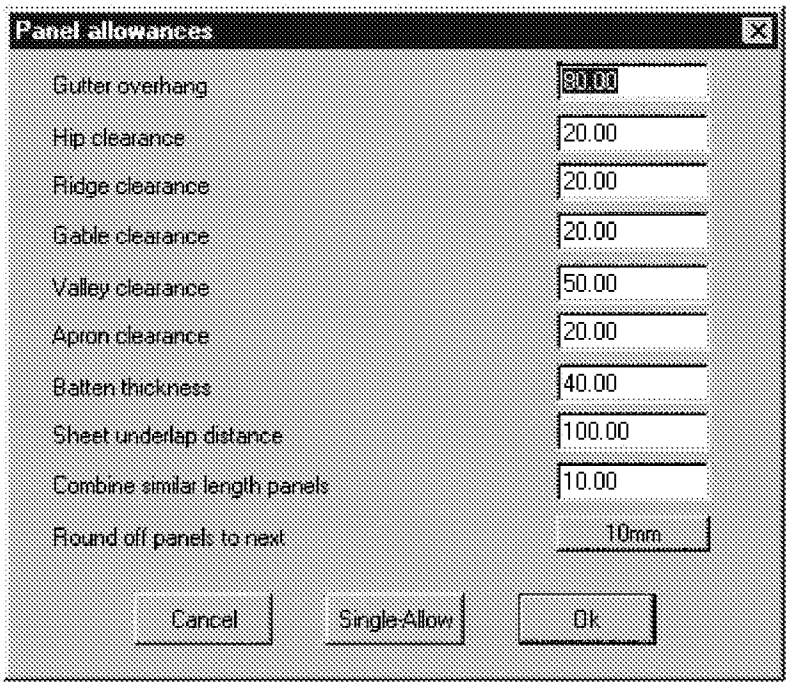
Linear-Nesting

This process takes all panels from the roof, orients them with respect to lap direction and sequentially

adds them together to form a single, continuous length of coil material. From the panel sequence list, individual panels are derived which form the basis of the cutting list. The list of sheets required and the resultant waste is displayed on a dialog box for you.
To print the results of the process, select **Drawings** and you will see a **Panel Sequence Drawing** and a **Panel Cutting Details** button. Clicking these will print those drawings. You can also see these results in models called RW-Sheet-Sequence and RW-Sheet-Cutting.

Allowances

Here you can set the standard allowances you want to apply for clearances around ridges, hips and valleys. Also you can allow for gutter overhang and the thickness of the battens in calculating the resultant panel lengths. These values are used by the **Estimate Offset-roof** command to generate the new roof planes.



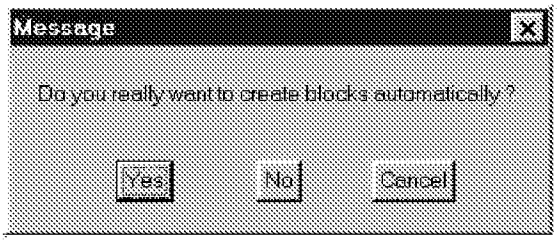
Gutter overhang	This is the amount to add to the panels for overhang into the gutter
Hip clearance	This is the clearance you want along a hip
Ridge clearance	This is the clearance you want along a ridge
Gable clearance	This is the clearance you want along a gable
Valley clearance	This is the clearance you want along a valley
Apron clearance	This is the clearance you want along a apron
Batten thickness	This is the batten thickness
Panel underlap distance	This is the distance one panel is overlapped by the next panel
Combine similar length sheets	After you generate a sheet list, sheet lengths which are less than this amount apart, are assumed to be the same length and are merged together. The shorter lengths are merged into the longer lengths.
Round off sheets to next	This toggles between 10mm and 100mm

When you click **Ok**, these values are saved for use in all jobs.

Auto-Block

This command constructs rectangular blocks using the roof geometry to generate sheet list.

After you click this command, you are prompted to confirm that you want to generate the blocks.



After you click **yes**, then the blocks are generated. If there are blocks already on the roof, they are first deleted.

After the blocks are generated, they are annotated with the number of sheets, sheet length as well as the pitch. There is also a hatching automatically applied to each block so they are identifiable. Also, the coverage direction of each block is defined by the side of the block which is highlighted (a fatter orange line).

Man-Block

This menu item displays a sub-menu, which provides a set of commands allowing you to manually insert and adjust the blocks.

Insert-Rect

This command lets you insert a block by digitizing two points.
After you select this command, you first enter the storey to which this block relates then the pitch for the block. Then you digitize 2 points which define the block extents. After you have located the second point, the block is drawn.

Now you are to select the side (line) which defines the coverage direction. Once you have done that, the number of sheets, sheet length and pitch is annotated on the block. The coverage direction defines the direction the sheets are to run, and therefore the number and length of sheets for this block, is totally dependent on the orientation of the coverage direction line.

Normally, the block orientation is square to the screen. In actual fact, it is square to the construction plane (CPL). The CPL defines which direction is x and which is y. If you need a block to orient itself such that it is not square to the screen, you'll have to change the CPL orientation using **Drawing CPL Change 3-Points**.

> Remember : the size of the text which annotates the block can be changed by using the **View Plot-Scale** command. The larger the value, the larger the text will be.

Insert-Line

This command lets you insert a block by selecting a line. The line defines the bottom left and top right hand corners of the block. Normally you would select a hip or valley line to insert the block.

After you select this command, you first enter the storey to which this block relates then the pitch for the block. Then you locate the line which defines the block extents. After you have located the line, the block is drawn.

Now you select the side (line) which defines the coverage direction. Once you have done that, the number of sheets, sheet length and pitch is annotated on the block.

Extend-Edge

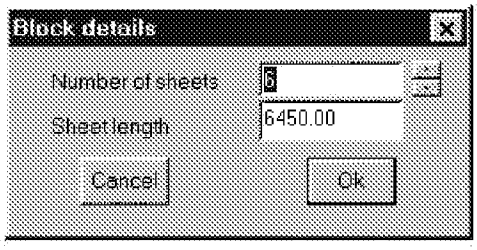
This command allows you to move an edge of a block, in effect re-sizing it. To extend an edge, simply click on the edge to move, then snap onto a point. After that, the edge is moved so it goes through that point, and the annotation of the block is updated.

Rotate

This command allows you to change the edge which defines the coverage direction.
Simply click on the block and you will notice, the coverage direction rotates to the next edge.

> There is no difference if the coverage direction line is the line on the opposite side of the block.

Change-details
This command allows you to change the details for a block without changing the physical size of the block. After selecting this command, you are then prompted to locate a block. You locate the block by clicking on the hatch lines which cover the block.
Then, the block details dialog box is displayed.
Here you can change the number of sheets and the sheet length for that block.



When you click **Ok**, the change you made is annotated on the block.

If you modify the block with another command (such as Extend-Edge or Rotate), the original values are restored.

> The values you see annotated on the block are the actual values accumulated to form the final sheet list. You can therefore use this command to alter your sheetlist if you desire.

Add-to-Verandah
This command allows you to apply a block to a bullnose verandah easily.

After you draw the bullnose verandah, you then insert a block to cover each segment. At the moment, the block has not taken the curve of the bullnose into account.

Then, to take the bullnose into account, you first select the verandah in question, then the block to effect. The block sheet length changes to take the curve into account. You should only perform this once, as it simply adds the difference between the straight length and the curved length.

Change-Pitch
This command allows you to change the pitch of block. After you have changed the pitch, the effective length of the sheets is changed to suit.

To change the pitch, select the Change-Pitch command, then the particular block. Then you are prompted to enter the new pitch. After you click Ok, the effective sheet length is recalculated and annotated on the block.

Show-Blocks
This command simply applies a hatch pattern to all the blocks in the model. You would use this to be able to visualize the blocks as well as being able to select the blocks easily.

Hide-Blocks
This command simply turns off the hatching from the blocks.

Delete-One
This command lets you delete blocks one by one.

Delete-All
This command deletes all the blocks in the model.

Verify
This command reports information about a selected block in the prompt area of the screen.

Merge-Blocks
This command automatically merges (combines) 2 or more blocks which share a common edge as well as have the same coverage direction. This process automatically checks all blocks in the current model.

This is performed automatically in the **Auto-Block** command and you should perform it if you have inserted any manual blocks.

Reduce-Runs
This command removes sheets from blocks based on there proximity to other blocks.

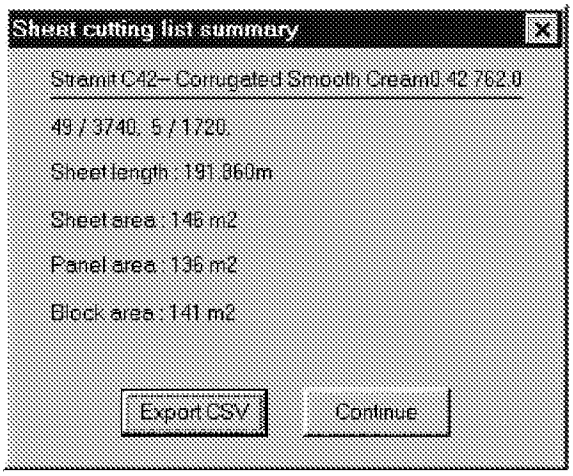
It does this by first creating runs of blocks which are a row of blocks which butt each other. Then, it determines the overall physical length of the run and calculates the number of sheets required for this run. It then compares this value, with the sum of the sheets associated with the blocks.

If there are more block sheets than run sheets, that number of sheets is removed from the annotations starting with the shorter length sheets.

This is performed automatically in the **Auto-Block** command and you should perform it if you have inserted any manual blocks.

Tally-Blocks
This command creates a sheet list from the blocks in the model.

It does this by accumulating all the annotations from each block in the model to create a consolidated list. You should have already set the cover for this roof, but if not, you will be prompted to do so. The lists will separate straight sheets from curved sheets.



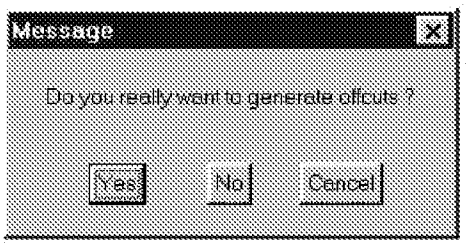
After the sheets are gathered, the Sheet cutting list summary dialog box is displayed.

You can also see on the summary, the total sheet length, sheet area, plane area and block area. If you want to export this list to a comma separated value file (.csv) for import into another computer system, click **ExportCSV**.

> Remember : if you want to alter the final sheet list, you can use the **Man-Block Change-details** command.

Gen-Offcuts
This command uses the second estimation method to generate a sheet list.

After you click this command, you are prompted to confirm that you want to generate offcuts.



After you click **Yes**, then the offcuts are generated. If there are offcuts already on the roof, they are first deleted.

From this offcut diagram, a final sheet list is displayed.

Del-Offcuts

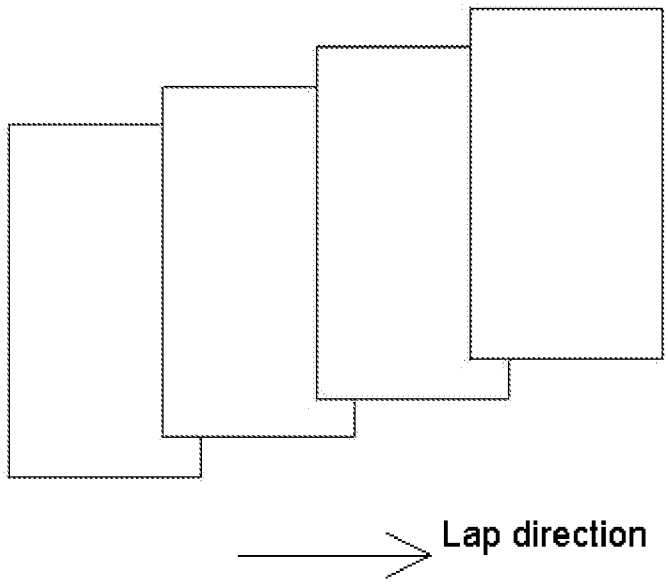
This command simply deletes the offcut areas from the model

Gen-Panels-All

This command automatically draws individual sheets on every roof plane in the model.

If you have not yet set the roof cover material with the **Cover Roofing** command, you will be prompted to do so. After that the sheets are generated.

The actual line you see on the roof plane is the line you see on the roof. The following diagram illustrates the lap direction



The lap direction is also used when generating the panels. The starting point for the lay is determined by the longest gable line on the roof plane and the lay direction and the panel underlap distance.

Gen-Panels-One

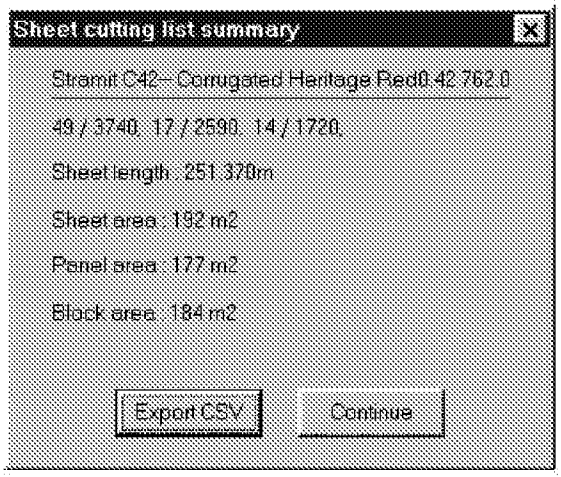
This command automatically draws individual sheets on a selected roof plane in the model. You would use this command to change the starting point of the sheets on a plane.

After you select the command, you are prompted to select the plane you want to generate the sheets on. Then you locate a point through which you want a sheet edge to go.

After you have located the point, the sheet alignment is updated to suit.

Del-Panels
This command simply deletes the sheets from the model.

Tally-Panels
This command creates a sheet list from the sheets in the model.
First, each sheet is given a unique identifier which is derived as a combination of a roof plane number and a sheet number.



Then, the sheet list is displayed on the Sheet cutting list summary dialog box.
If you want to export this sheet list to a comma separated value file (.csv) for import into another computer system, click **ExportCSV**.

> Remember : this method assumes that offcut will not be used. The sheet length reported is therefore the maximum length of each sheet.

Ins-Lap-Dir
This command lets you draw an arrow on the model which shows the lap direction the installer should follow. The size of the arrow is fixed at 1000mm. The actual plot size will vary based on the final plot scale. The lap direction is used by the **match-panels** and **linear nesting** commands to produce a cutting list.

Ins-Lap-Dir-Auto
This command automatically draws lap direction arrows on the model which shows the lap direction the installer should follow. The size of the arrow is fixed at 1000mm. The actual plot size will vary based on the final plot scale.

Swap-Lap-Dir
This command lets you swap the direction of a lap arrow if you want to change the direction easily.

Del-Lap-Dir
This command lets you delete a lap direction arrow.

View-Panellist
This command displays the previous sheet list you generated.

Offset roof
This command automatically creates an offsetted roof given the clearance values and the batten thickness you set in the **Estimate Allowances** dialog box.

Del-Offset

This command deletes the offsetted roof planes created by **Offset-Roof.**

Match-Panels

The panel matching process is dependent not only on the geometric end shape, but also, the lap direction of the matching panel. If the lap direction of a geometrically matching panel is not defined, then the lap direction is inherited from the initial panel. Also, all panels on that particular roof plane have their lap direction defined also. If the lap direction is defined for the matching panel, then it is used to determine whether the match is suitable or not.

After the nesting process, the panel cutting list is displayed, detailing the sheet wastage and total sheet area.

Linear Nesting

This process takes all panels from the roof, orients them with respect to lap direction and sequentially adds them together to form a single, continuous length of coil material. From the panel sequence list, individual panels are derived which form the basis of the cutting list.
During the process, you see the generation of the panel sequence diagram and the panel detail diagrams. After the process these diagrams are saved in their own files and are deleted from the current model.
You can see the panel sequence diagram in the model called *RW-Sheet-Sequence* in the same database as the roof model. The entire panel sequence is automatically broken into smaller strips ready for it to be printed on A4 landscape format at a scale of 1:100. The entire sequence may also span multiple pages.
You can see the panel cutting diagrams in the model *RW-Sheet-Cutting* in the same database as the roof model. The individual panels are automatically positioned to fit on an A4 drawing at a scale of 1:100.

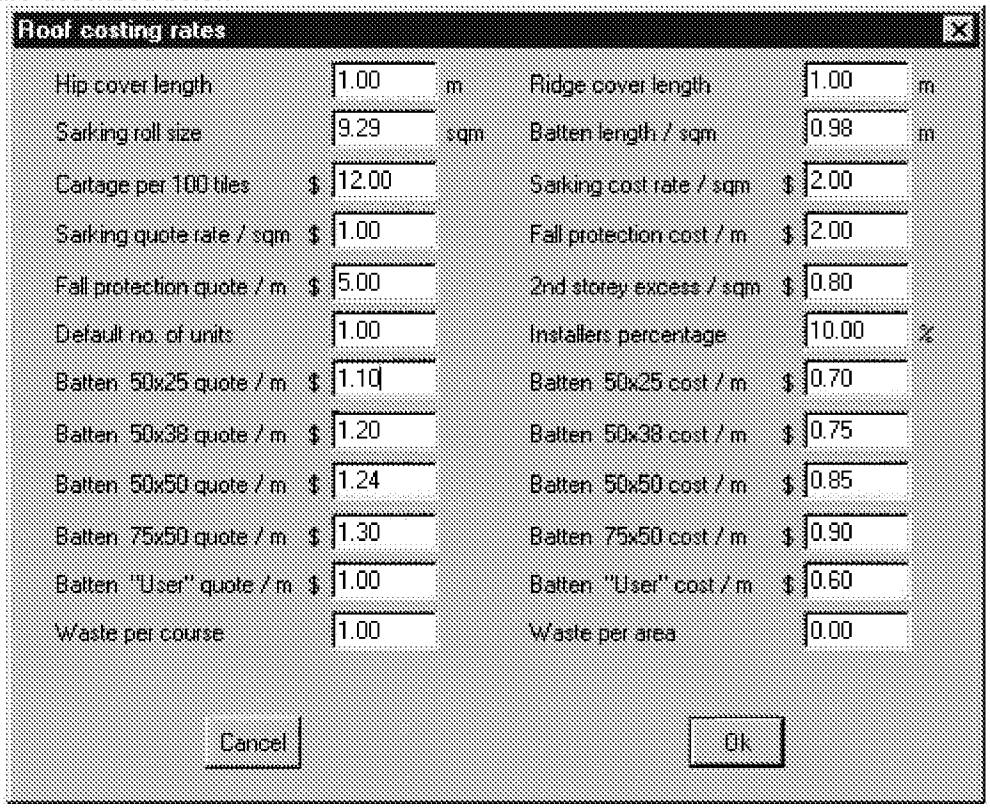
As part of the process, a PCF (Piece Coordinate File) is written detailing the coordinate perimeter of each piece on each sheet. Refer to the appendix for the format of the piece coordinate file. The actual name of the PCF file is <*databasename*>*.PCF*

Costing

These commands provide you with the ability to create a final quote for the job, as well as set labor costs.

Tile-Rates

This command displays the Roof Costing-Rates dialog box allowing you to set or change various quote rates and job cost rates associated with the estimate.
The items are described below

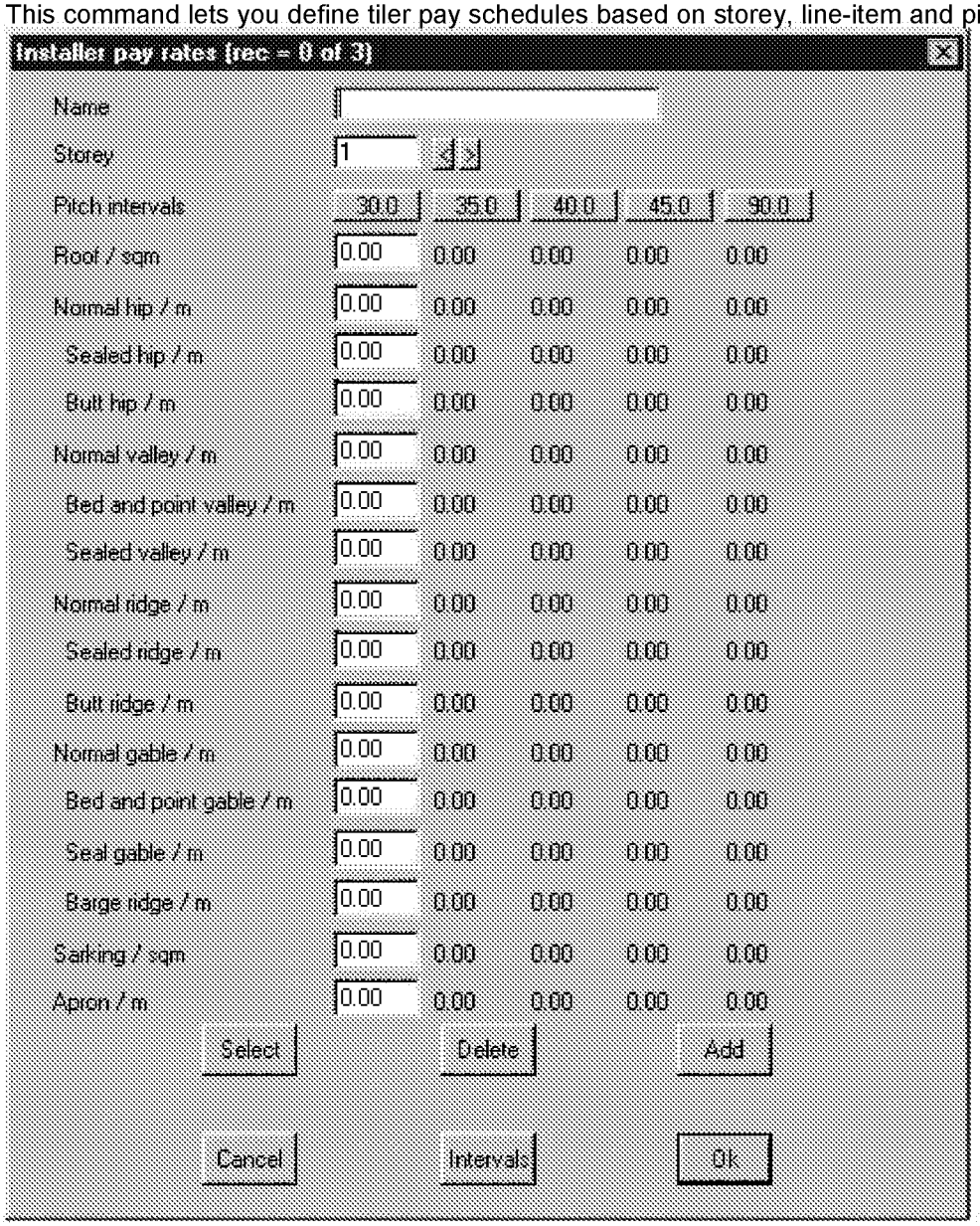


Hip cover length	This value determines the number of hip tiles required. It is independent of the tile you selected. Note that it is not used if you have supplied a hip tile length when you defined the tile using **Cover Define-Materials**
Sarking roll size	This value determines the number of rolls of sarking
Cartage per 100 tiles	This value determines the total delivery cost.
Sarking quote rate	This is the rate to quote sarking
Fall protection quote	This is the rate to quote fall protection
Default no of units	This is the default number of housing units for this job
Batten 50x25 quote	This is the rate to quote 50x25 battens
Batten 50x38 quote	This is the rate to quote 50x38 battens
Batten 50x50 quote	This is the rate to quote 50x50 battens
Batten 75x50 quote	This is the rate to quote 75x50 battens
Batten User quote	This is the rate to quote the user defined batten
Ridge cover length	This value determines the number of ridge tiles required. It is independent of the tile you selected. Note that it is not used if you have supplied a ridge tile length when you defined the tile using **Coverage Define**.
Batten length	This is the length of battens per m2 of roof. It is used if you perform the estimate using the area method.
Sarking cost rate	This is the cost of the sarking
Fall protection cost	This is the cost of the fall protection
2nd storey excess	An extra value for second storey work
Installers percentage	The extra percentage to apply to the installers pay

Batten 50x25 quote	This is the cost of 50x25 battens
Batten 50x38 quote	This is the cost of 50x38 battens
Batten 50x50 quote	This is the cost of 50x50 battens
Batten 75x50 quote	This is the cost of 75x50 battens
Batten User quote	This is the cost of the user defined batten
Waste per course	The number of tiles you want to add per course if using the coursing method
Waste per area	The number of tiles you want to add per unit area if using the area estimation method

Tile-Pay

This command lets you define tiler pay schedules based on storey, line-item and pitch.

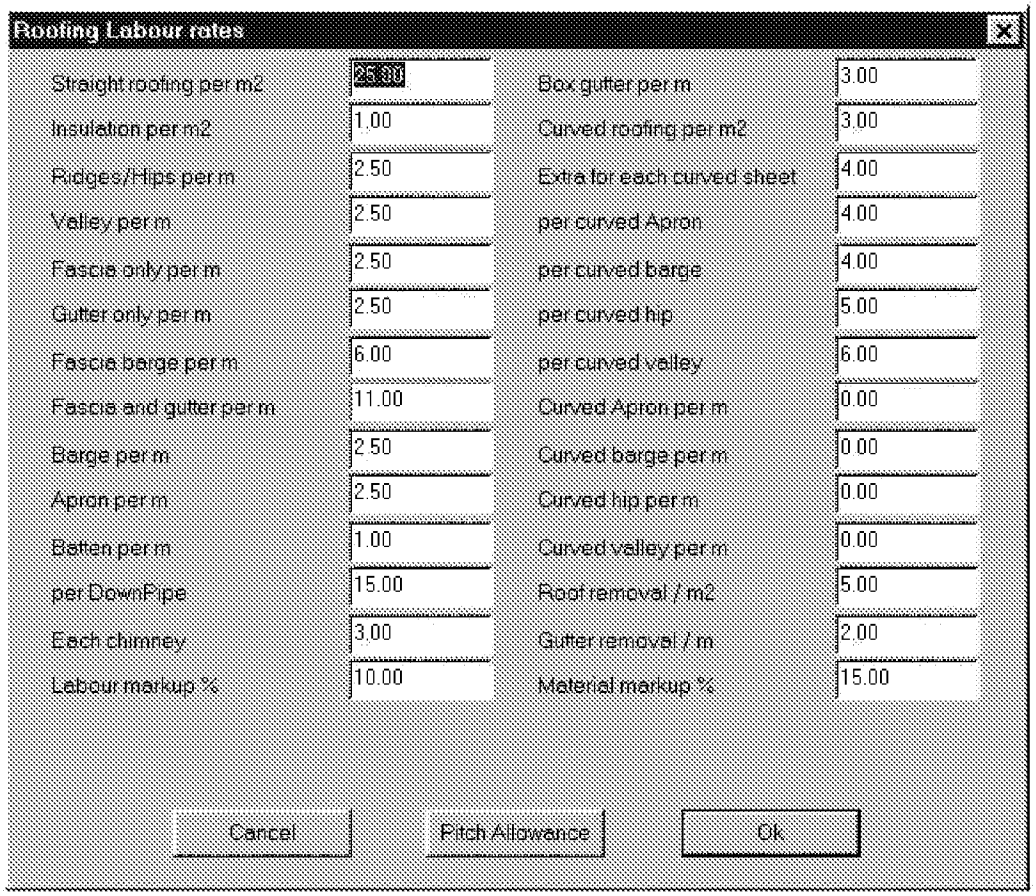


Name	This is the name by which you select this pay rate in future
Storey	This is the storey to which these values relate. You can have up to 10 stories for the one pay rate
Pitch intervals	These values reflect those you set with the Intervals button at the bottom of the dialog box. For each pitch interval value, you get a column of numbers associated with a line item. To edit a line item, highlight that column by clicking the pitch interval label.
Roof / sqm	This is the installer rate to lay tiles on the roof.

....	The reset of the line items relate to hip, valley, gable and barge finishes you select under **Cover Select-tile**.
Select	This allows you to select an existing pay rate schedule
Delete	This allows you to delete an existing pay rate schedule
Add	This allows you to add a new pay rate schedule
Update	This allows you to update an existing pay rate schedule

Metal-Rates

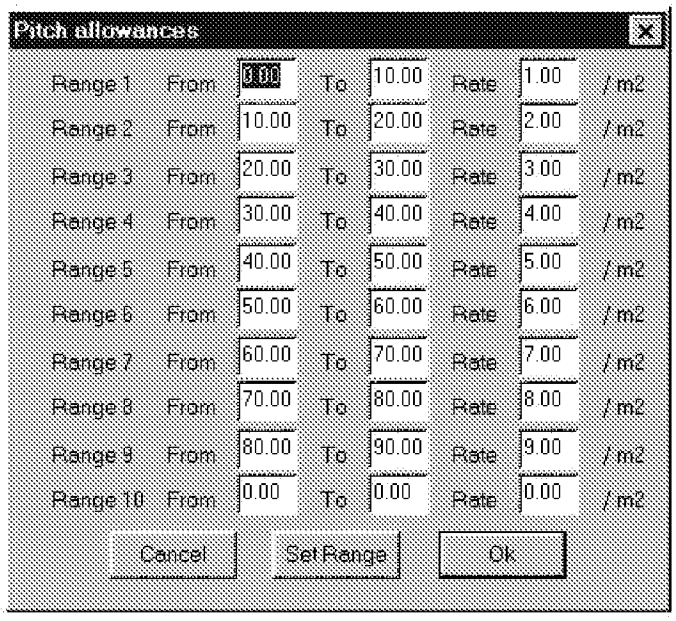
This command displays the Roofing Labor rates dialog which allows you to set installation rates for different categories of roofing items.
The following table describes the rates.



Labor rate	Description
Straight roofing per m2	The rate to install straight sheeting on the roof (or verandah)
Insulation per m2	The rate to lay the insulation
Ridges/hips per m	The rate to install the ridges and hips
Valley per m	The rate to install valley flashing
Fascia only per m	The rate to install fascia flashing only
Gutter only per m	The rate to install gutter only
Fascia barge per m	The rate to install fascia on a barge
Fascia and gutter per m	The rate to install fascia and gutter together
Barge per m	The rate to install barge flashing
Apron per m	The rate to install apron flashing
Batten per m	The rate to install battens
Each Downpipe	The amount to install each downpipe
Each chimney	The rate to cater for each chimney
Labor markup %	The percentage the total labor cost will be marked up in the final costing
Box gutter per m	The rate to install box gutter

Curved roofing per m2	The rate to install the curved sheeting on the roof (or verandah)
Each curved sheet	The amount to add for each curved sheet
Per curved apron	The amount to add for each curved apron (bullnose verandahs)
Per curved barge	The amount to add for each curved barge (bullnose verandahs)
Per curved hip	The amount to add for each curved hip (bullnose verandahs)
Per curved valley	The amount to add for each curved valley (bullnose verandahs)
Curved apron per m	The rate to install curved apron (bullnose verandah)
Curved barge per m	The rate to install curved barge (bullnose verandah)
Curved hip per m	The rate to install curved hip (bullnose verandah)
Curved valley per m	The rate to install curved valley (bullnose verandah)
Roof removal per m2	The rate for roof removal
Gutter removal per m	The rate for gutter removal
Material markup %	The rate to markup the material costs for the final quote

After you make a change and click **Ok**, the changes are saved in *rates.bin* for use in all future jobs.
If you click **Pitch Allowances**, the Pitch Allowance dialog box is displayed.
Here, you set the pitch ranges as well as the rate to apply for planes in that range. When you click



Set Range, you can change the number of ranges. The maximum number of ranges you can have is 10. These values are used in the labor charge calculation under **Costing Supply+Install**. Each plane in the model is tested for its pitch and area, and based on the pitch, the above table is inquired to derive a pitch allowance. The individual pitch allowances are added together to derive the total pitch allowance.