MOVING FROM 5 TO 6 STAR

A series of five star homes and examples of what you need to do to achieve the new six star standard.

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Introduction

The mandatory 6 Star domestic housing regulations have been added to the Building Code of Australia 2010. These regulations are expected to take effect in Victoria in May 2011. The new regulations are a response from the National Strategy on Energy Efficiency. A number of these strategies focus on: assisting households and businesses to transition to a low-carbon future, reducing impediments to the uptake of energy efficiency and making buildings more energy efficient.

Through the use of practical examples this booklet helps to clarify what these changes will mean to builders for new house construction.

Ten sets of house plans of a variety of types and sizes were examined, including slab and suspended timber floor construction.

The plans were rated using First Rate 5 software, to determine what would be required to increase the rating from the current 5 Star requirement to 6 Star, using the most cost effective methods. The possible methods were considered from the perspective of a builder with limited scope to alter the design.

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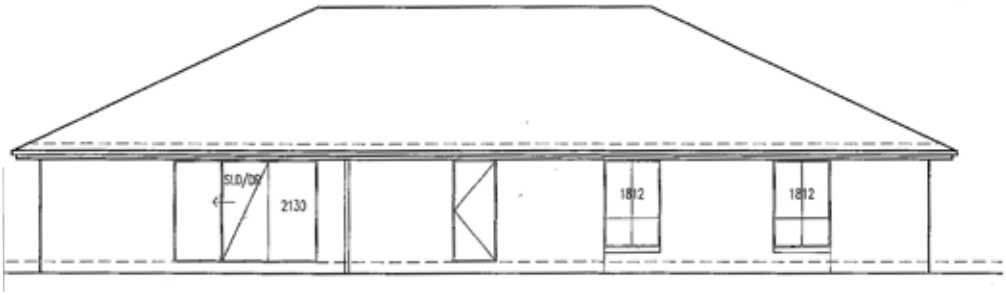
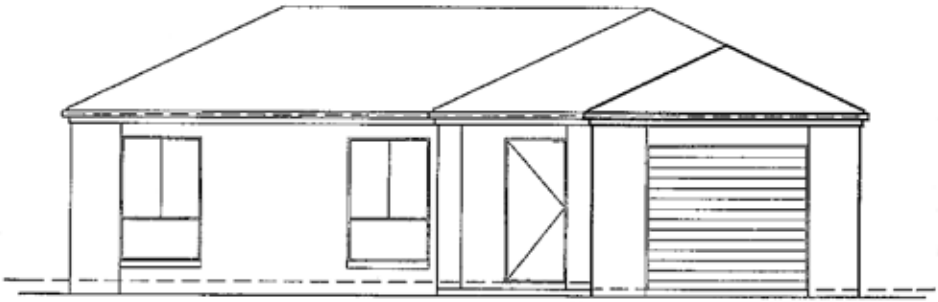
CASE STUDY 1



Name	Baynton		
Description	Single storey house, located 20kms from Kyneton. 4 bedrooms, a study and no garage. Brick veneer with tiled roof, built on concrete slab on ground. Carpet and tile floor coverings.		
Size	216 m2		
Passive Solar Design	Good - simply designed energy efficient house. Is well zoned, with small to medium sized rooms that can be closed off and not heated or cooled when not in use. Effective wall to floor ratio - low surface area to volume ratio - reducing heat loss through walls and windows. Not overly glazed or heavily shaded by eaves or an alfresco. Living areas however face south east which is not ideal as winter solar heat gain is reduced.		
House Rating	5 Star	6.2 Star	
Ceiling Insulation Roof	R2.5	**R3.5**	
External Wall Insulation Batts	R1.5	R2	
Internal Wall Insulation Batts	No	No	
Single Glazed Windows	Yes	No	
Double Glazed Windows	No	Yes	
Entry Doors Sealed	No	**Yes**	
Exhaust Fans Sealed	No	**Yes**	
Additional Requirements	Wall insulation R1.5 to R2		$103
	Ceiling Insulation R2.5 to R3.5		$465
	Entry doors sealed and exhaust fans sealed		$300
Cost	$865		
Cost/ m2	$4		

Legend: DS-Double sided reflective foil, **SS**-Single sided reflective foil

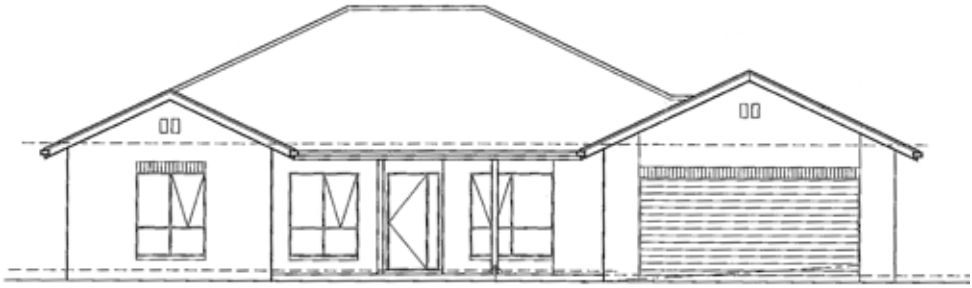
CASE STUDY 2



Name	Sunbury (Underhill)	
Description	Single storey, 3 bedroom house. Brick veneer with tiled roof, built on concrete slab on ground. Tile and carpet floor coverings.	
Size	137 m2	
Passive Solar Design	Good - low ratio of windows to floor area reducing heat loss. Rooms well zoned that can be closed off and not heated or cooled when not in use. Meals and family areas face north, north west and south west allowing heat gain from winter sun.	
House Rating	5 Star	6 Star
Slab	Raft	Raft
Sub Floor Insulation	SS	SS
Ceiling Insulation Roof	R2.5	**R3.5**
Ceiling Reflective Foil Roof	SS	SS
External Wall Insulation Batts	R1.5	**R2**
External Wall Reflective Foil	SS	SS
Internal Wall Insulation Batts	No	No
Single Glazed Windows	Yes	Yes
Double Glazed Windows	No	No
Additional Requirements	External wall insulation increased from R1.5 to R2	$82
	Aluminium standard windows upgraded to improved aluminium windows reducing heat loss and gain through frames	$600
	Ceiling insulation increased from R2.5 to R3.5	$270
	Entry doors sealed and exhaust fans sealed	$300
Cost	$1265	
Cost/ m2	$9	

Legend: 1F-1st floor, **DS**-Double sided reflective foil, **SS**-Single sided reflective foil

CASE STUDY 3



Name	Sunbury (Swift St)		
Description	Single storey, 4 bedroom house. Brick veneer with raised timber flooring. Tile and carpet floor coverings.		
Size	300 m2		
Passive Solar Design	Good - not overly glazed with good proportion of windows to floor area reducing heat loss in winter and effective zoning of rooms that can be closed off and not heated or cooled when not in use. Living areas north and north-west facing allowing heat gain from winter sun.		
House Rating	5 Star	6 Star	
Underfloor Insulation	No	**R1.5**	
Ceiling Insulation Roof	R3.5	**R4**	
Ceiling Reflective Foil Roof	SS	SS	
External Wall Insulation Batts	R2	R2	
External Wall Reflective Foil	SS	SS	
Internal Wall Insulation Batts	No	**R2**	
Single Glazed Windows	Yes	Yes	
Double Glazed Windows	No	**Yes**	
Sealed Wall Cavity	No	**Yes**	
Additional Requirements	Under floor insulation added (R1.5)		$1578
	Internal wall insulation added to bathrooms and laundry wall (R2)		$335
	Ceiling insulation increased from R3.5 to R4		$510
	Single glazed windows changed to double glazed in living areas		$1540
	Sealed brick veneer wall cavity at base		$150
Cost	$4115		
Cost/ m2	$14		

Legend: SS-Single sided reflective foil

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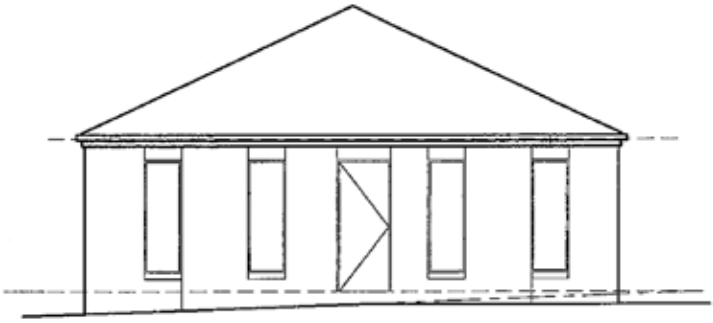
CASE STUDY 4

Name	Gisborne (Dalton St)		
Description	Single storey house, 4 bedrooms. Brick veneer with tiled roof, built on concrete slab on ground. Carpet and tile floor covering.		
Size	327 m2		
Passive Solar Design	Good - family, meals and kitchen areas facing north, north east and south east allowing heat gain from winter sun.		
House Rating	5.3 Star	6 Star	
Slab	Raft	**Waffle**	
Ceiling Insulation Roof	R3.5	R3.5	
Ceiling Reflective Foil Roof	SS	SS	
External Wall Insulation Batts	R2	R2	
Internal Wall Insulation Batts	No	**R2**	
Single Glazed Windows	Yes	No	
Double Glazed Windows	No	**Yes (5)**	
Additional Requirements	Raft slab changed to waffle pod slab		$2800
	Single glazed windows and doors changed to double glazed in lounge, kitchen, meals and rumpus room		$1760
	Internal wall insulation added to laundry and bathroom (R2)		$312
Cost	$4872		
Cost/ m2	$15		

Legend: 1F-1st floor, **DS**-Double sided reflective foil, **SS**-Single sided reflective foil

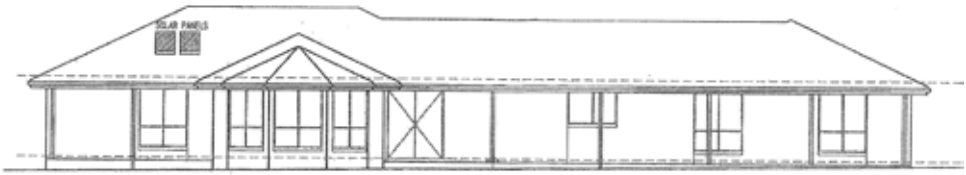
CASE STUDY 5



Name	Kilmore (Wattlebird Way)	
Description	Single storey house, 2 bedrooms. Brick veneer with tiled roof. Raised timber flooring with tile and carpet floor coverings.	
Size	101 m2	
Passive Solar Design	Good - living areas facing north-east and north-west allowing in winter sun to warm home. Small house and not overly glazed reducing heat loss through windows in winter.	
House Rating	5.2 Star	6.1 Star
Underfloor Insulation	No	**R1.5**
Ceiling Insulation Roof	R2.5	**R3.5**
Ceiling Reflective Foil Roof	SS	SS
External Wall Insulation Batts	R1.5	**R2**
Internal Wall Insulation Batts	No	**R2**
Single Glazed Windows	Yes	Yes
Double Glazed Windows	No	**Yes (living areas)**
Additional Requirements	Timber floor insulation added (R1.5)	$600
	Ceiling insulation increased from R2.5 to R3.5	$205
	External wall insulation increased from R1.5 to R2	$70
	Internal wall insulation added to laundry (R2)	$140
	Single glazed windows changed to double glazed in living areas	$715
Cost	$1730	
Cost/ m2	$17	

Legend: DS-Double sided reflective foil, **SS**-Single sided reflective foil

CASE STUDY 6



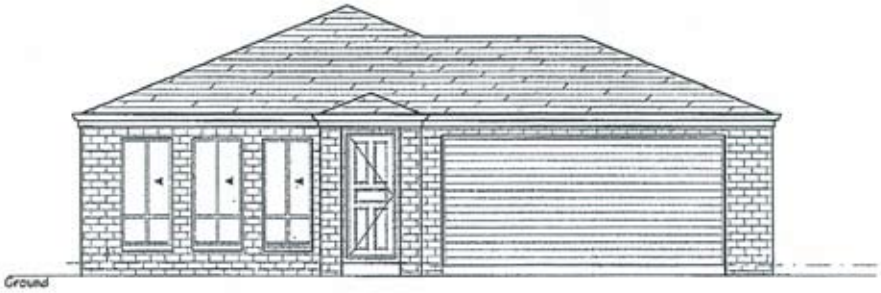
Name	Gisborne (Alexander)
Description	Single storey house in Gisborne. Brick veneer with tiled roof, built on concrete slab on ground. 4 large bedrooms, verandah, large family, dining and meals area.
Size	270 m2 (includes verandah)
Passive Solar Design	Poor - large north-east facing verandah to the front adds extra shading reducing solar gain in winter. Deep L shaped external walls increases wall area and shading lowering the rating. Window to floor area is excessive increasing heat gain in summer through walls and windows. Living areas are orientated to the south-west which means no heat gain in winter and excessive heating by low western sun.

House Rating	5.1 Star	6.1 Star
Slab	Raft	**Waffle**
Ceiling Insulation Roof	R3.5	**R4**
Ceiling Reflective Foil Roof	SS	SS
External Wall Insulation Batts	R2	R2
Internal Wall Insulation Batts	No	**Yes**
Single Glazed Windows	Yes	No
Double Glazed Windows	No	**Yes**

Additional Requirements	Raft slab to waffle pod slab	$1200
	Ceiling insulation R3.5 to R4	$420
	Internal wall insulation to the laundry, bath and powder room	$275
	Single glazed windows in family, dining, meals, kitchen and lounge changed to double glazed windows	$2970
Cost	$4860	
Cost/ m2	$18	

Legend: DS-Double sided reflective foil, **SS**-Single sided reflective foil

CASE STUDY 7



Name	Deer Park		
Description	Single storey, 4 bedroom house. Brick veneer with tiled roof, built on concrete slab on ground. Tile, timber and carpet floor coverings.		
Size	262 m2		
Passive Solar Design	Poor - alfresco area on north side restricting amount of sunlight penetration in winter which will reduce heat gain and require more artificial heating.		
House Rating	5.4 Star	6 Star	
Ceiling Insulation Roof	R3.5	**R5**	
Ceiling Reflective Foil Roof	SS	SS	
External Wall Insulation Batts	R2	**R2.5**	
Internal Wall Insulation Batts	No	**R2**	
Single Glazed Windows	Yes	**No**	
Double Glazed Windows	No	**Yes (7)**	
Additional Requirements	Roof ceiling insulation increased from R3.5 to R5		$2112
	External wall insulation increased from R2 to R2.5		$797
	Internal wall insulation batts added to garage walls (R2)		$503
	Single glazed aluminium windows changed to double glazed on northern elevation		$1700
Cost	$5112		
Cost/ m2	$20		

Legend: DS-Double sided reflective foil, **SS**-Single sided reflective foil

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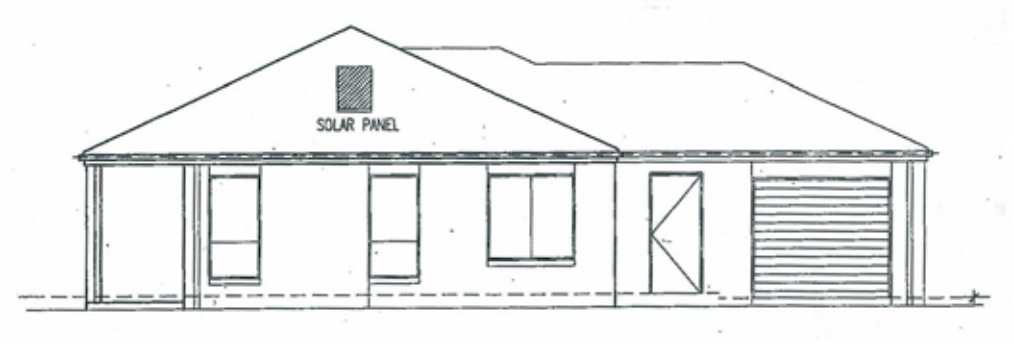
CASE STUDY 8



Name	Woodend	
Description	Single storey, 2 bedroom house. Brick veneer with tiled roof, built on concrete slab on ground. Tile and carpet floor coverings.	
Size	145 m2	
Passive Solar Design	Good - cold climate zone with north facing living areas allowing in winter sun to warm home. Small and well zoned with minimal east and west facing glazing reducing heat gain in summer.	
House Rating	5 Star	6.1 Star
Ceiling Insulation Roof	R3	**R6**
Ceiling Reflective Foil Roof	SS	SS
External Wall Insulation Batts	R1.5	**R2**
Internal Wall Insulation Batts	No	**R1.5**
Single Glazed Windows	Yes	Yes
Double Glazed Windows	No	No
Additional Requirements	External wall insulation increased from R1.5 to R2	$60
	Ceiling insulation increased from R3 to R6	$2398
	Internal wall insulation added to garage and bedroom areas (R1.5)	$1060
Cost	$3048	
Cost/ m2	$21	

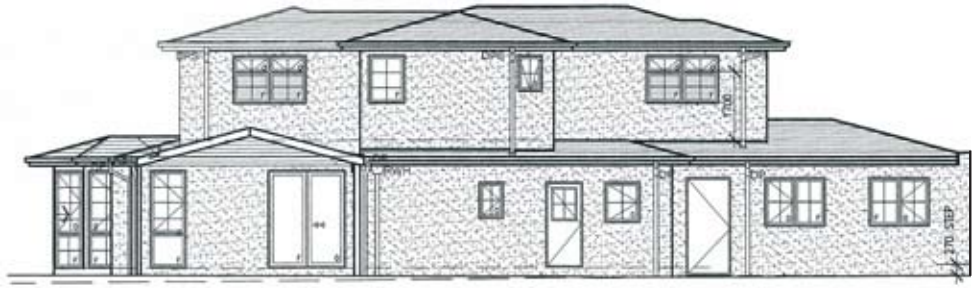
Legend: DS-Double sided reflective foil, **SS**-Single sided reflective foil

CASE STUDY 9

Name	St Albans	
Description	1 unit of a 2 unit development. Single storey with 2 bedrooms and a garage. Brick veneer with north facing fibre cement wall. Concrete slab on ground with metal roof. Floor coverings are tiles and carpet.	
Size	86 m2	
Passive Solar Design	Good - living and dining areas on northern side allowing in winter sun reducing heating requirement in winter. Small rooms with effective zoning allowing them to not be heated or cooled when not being used. The design is let down by large western glazed doors that are likely to lead to heat gain in summer.	
House Rating	5.3 Star	6.0 Star
Ceiling Insulation	R3.5	**R6**
Ceiling Reflective Foil	SS	SS
External Wall Insulation Batts	R1.5	**R2**
External Wall Reflective Foil	SS	SS
Internal Wall Insulation Batts	None	**R2**
Single Glazed Windows	Yes	Yes
Double Glazed Windows	No	**1**
Additional Requirements	Ceiling insulation R3.5 to R6	$1270
	Wall insulation R1.5 to R2	$47
	Internal wall insulation 0 to R2	$380
	One aluminium double glazed window added to dining room	$535
Cost	$2232	
Cost/ m2	$26	

Legend: DS-Double sided reflective foil, **SS**-Single sided reflective foil

CASE STUDY 10



Name	Mont Albert		
Description	Double storey unit with 3 bedrooms and double garage. Brick veneer with tiled roof, built on concrete slab on ground. Cladding on ground floor and 75mm polystyrene cladding on upper storey. Floor coverings are tiles, timber and carpet.		
Size	260 m2		
Passive Solar Design	Poor - family room facing north but considerable amount of glazing overall (45 m2), particularly on the eastern elevation causing excessive heating from morning sun in summer.		
House Rating	5.2 Star	6 Star	
	Brick veneer and poly 75 mm	Brick veneer and **poly 100mm**	
Ceiling Insulation 1F	R4	**R6**	
Ceiling Insulation Roof	R6	R6	
External Wall Insulation Batts	R2	**R2.5**	
Internal Wall Insulation Batts	No	**R2**	
Single Glazed Windows	Yes	**No**	
Double Glazed Windows	No	**Yes (all)**	
Additional Requirements	1st floor wall cladding increased in thickness from 75 mm to 100 mm polystyrene		$2970
	1st floor ceiling insulation increased from R4 to R6		$1815
	External wall insulation batts increased from R2 to R2.5		$1184
	Internal garage wall insulation added (R2)		$267
	Windows single glazed aluminium changed to double glazed		$4620
Cost	$10,856		
Cost/ m2	$42		

Legend: 1F-1st floor

Discussion

Table One – Summary of Costs				
Case Study	Description	Size m2	Cost m2	Total cost
1	House - 1 storey	216	$4	$865
2	House - 1 storey	137	$9	$1265
3	House - 1 storey	300	$14	$4115
4	House - 1 storey	327	$15	$4872
5	House - 1 storey	101	$17	$1730
6	House - 1 storey	270	$18	$4860
7	House - 1 storey	262	$20	$5112
8	House - 1 storey	145	$21	$3048
9	Unit - 1 storey	86	$26	$2232
10	Unit - 2 storey	260	$42	$10,856

Typical costs for the case studies examined in this project ranged from $4 m2 for a small, extremely well designed house (Case Study 1) to $42 m2 for a poorly designed two storey unit with a large amount of glazing (Case Study 10). Exclusion of Case Study 10 puts the next most expensive upgrade from 5 to 6 Star at $26 m2 for a single- storey unit with large glazed areas to the west (Case Study 9).

For the majority of the case studies (9 of the 10), build costs were in the range of $4 to $26 m2, with total costs ranging from $865 to $10,856 for a poorly designed two storey unit.

The total cost per dwelling was closely related to the design of the house. Houses which were oriented to the north (allowing for winter heat gain from the sun), with moderate glazing (reducing heat loss) and appropriate shading (reduced heat gain in summer) were less costly to improve. The size of the house also had a large effect on the total cost of improvement with large houses with poor passive solar design being the most costly to bring up to the 6 Star standard. Applying passive solar design principles early in the design process is likely to lead to significantly lower costs than were found in upgrading poorly designed houses.

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Conclusion

The estimated cost of increasing the building thermal performance of the case study buildings from 5 to 6 Star was often linked to the quality of the passive solar design. All case studies were considered from the perspective of a builder with limited scope to alter the design. Therefore, poor designs were going to be more expensive to modify in order to achieve the required standard.

It is much easier to reduce the build costs associated with achieving the 6 Star Standard by having the plans rated earlier in the design process or by working with designers that are familiar with passive solar design principles.

Good orientation, appropriate shading and the inclusion of thermal mass contribute the most to thermal performance and these factors can usually be integrated at little or no cost at the early design stages.

8 Quick Tips For Increasing Your Star Rating

- Waffle pod slabs can increase the rating by 0.1 to 0.3 of a star.
- Double glazed windows can add 0.6 to 0.8 of a star.
- Sealing the external doors and using sealed exhaust fans can add 0.5 of a star.
- Sealing the brick veneer wall cavity can improve ratings on timber floored houses by 0.5 of a Star.
- Simple shaped buildings help to improve the rating performance.
- Orientate the living areas to the north side of the home.
- Zoning of rooms can increase the rating.
- Avoid excessive glazing.

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