

Development of AccuRate Xpress – Stage 1

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EXECUTIVE SUMMARY

Regulatory building thermal performance assessment tool requires the balances between fast parameter input for high productivity and comprehensiveness of the input information for accurate building representation; between flexibility parameter input for coping complex or innovative building designs and the rigorousness and unambiguousness of the input information for reducing input errors. Existing AccuRate provides almost unlimited construction design capacity. This powerful design facility is enjoyed by experienced assessors and designers. However, it requires more user inputs and potentially is prone to input errors for inexperienced users.

Discussions between then DEWHA (the Department and Environment, Water Heritage and the Arts), ABSA and CSIRO suggested that an Xpress mode of AccuRate should be developed. AccuRate Xpress should provide a more user friendly with reduced input (with lock-down fields) version of the AccuRate tool based on wide provisions of 'generic' construction systems. By providing commonly used constructions and lock-down fields, AccuRate Xpress will be faster to use and will be less likely to result in input ambiguity and user errors.

CSIRO was commissioned by then DEWHA (now in the Department of Climate Change and Energy Efficiency (DCCEE)) for Stage 1 AccuRate Xpress development in March 2010. Stage 1 of the AccuRate Xpress development accomplished the following deliverables:

- a. On the project page, the client details, assessor details and the site location details can be saved to file for future use;
- b. Graphical selection of house surrounding terrain;
- c. Automatic creation of bedroom zones based on number of bedrooms specified;
- d. Explicit creation of roof space & subfloor zone;
- e. Automatic creation of other new zone & zone attributes using predefined zone types;
- f. Automatic assignment of the floor and zone height using the story floor and story height;
- g. A fixed shading scheme used for an external wall element cannot be used by the windows in this wall and vice versa.
- h. An external wall library with interactive insulation insertion, reflective foil selection and accompanying images should be implemented and should demonstrate its use;
- i. Window schedule construction with interactive pane images and opening types should be implemented and demonstrate its use.

This report details Stage 1 AccuRate Xpress development.

1. BACKGROUND

Thermal performance simulation programs such as AccuRate offer a powerful tool for assessing building energy efficiency, optimising energy efficient house designs, encouraging innovations and assisting building regulators and governments in formulating standards and policies. In order to provide the flexibility to ensure that experienced assessors and designers can assess a house with innovative or complex constructions, existing AccuRate (including the latest AccuRate Version 1.1.4.1) provides almost unlimited construction design capacity. This powerful design facility is, on one hand, enjoyed by experienced assessors and designers. On the other hand, it requires more user inputs and potentially is prone to user input errors.

Discussions between then DEWHA, ABSA and CSIRO suggested that a 'regulatory mode' of AccuRate (later renamed as AccuRate Xpress) should be developed. AccuRate Xpress should be built on some of the work previously undertaken with the fast input mechanism (Khoo *et al*, 2009) to provide a more user friendly with reduced input (with lock-down fields) version of the AccuRate tool based on wide provisions of 'generic' construction systems. By providing commonly used constructions and lock-down fields, AccuRate Xpress will be faster to use and will be less likely to result in input ambiguity and user errors.

CSIRO was commissioned by then DEWHA (now in DCCEE) to develop AccuRate Xpress in early March 2010 with the following deliverables:

- 1) Identify "Fast Input" items and aspects to minimise potential user errors and to facilitate faster user input;
- 2) Construct generic libraries with information provided by the Residential Building Group in the then DEWHA (now in DCCEE);
- 3) Design user interface for AccuRate Xpress;
- 4) Implement online help for AccuRate Xpress;
- 5) Test AccuRate Xpress by experienced assessors;
- 6) Finalize AccuRate Xpress and release.

In the development of AccuRate Xpress, fast input concepts similar to those in the previous fast input mechanism project have been identified which include:

- a. On the project page, the client details, assessor details and the site location details can be saved to file for future use;
- b. Graphical selection of house surrounding terrain;
- c. Automatic creation of bedroom zones based on number of bedrooms specified;
- d. Explicit creation of roof space & subfloor zone;
- e. Automatic creation of other new zone & zone attributes using predefined zone types;
- f. Automatic assignment of the floor and zone height using the story floor and story height;
- g. Properly check the validity of the input data in all the above items.

During the process of defining the lock-down libraries, a number of areas were identified which can be improved through further modifications of the element input page by using window schedules, shading and screen schemes, graphical visualization of windows and shadings, automatic calculation of translucent verandas solar transmissions, simplified internal wall opening inputs. It was also suggested that a number of the items in the ABSA streamline report should be considered for implementation.

Both DCCEE and CSIRO recognize that these identified areas are extremely valuable in reducing the ambiguity for user input and in speeding up the input at the same time. However, the implementation of these improvements will require a second stage of the AccuRate Xpress project.

It is suggested that the current stage (Stage 1) of the AccuRate Xpress project should be completed with the implementation of the following aspects in addition to the identified aspects a) to g):

- h. A fixed shading scheme used for an external wall element cannot be used by the windows in this wall and vice versa.
- i. Implement relevant online help for aspects a) to g)
- j. An external wall library with interactive insulation insertion, reflective foil selection and accompanying images should be implemented and should demonstrate its use;
- k. Window schedule construction with interactive pane images and opening types should be implemented and demonstrate its use.

Stage 2 of the AccuRate Xpress project will include the following tasks:

1. Implement internal wall, floor/ceiling libraries with interactive insulation insertion, reflective foil selection and accompanying images and their related element input;
2. Implement shading, external screen schemes and wing wall with graphical guidance and their related element input;
3. Automatically calculate translucent verandas solar transmissions;
4. Implement subfloor ceiling to multiple zones above;
5. Implement roof space floor to multiple zones under;
6. Simplify internal wall opening inputs using single or double door sizes;
7. Implement online help for AccuRate Xpress;
8. Deliver a trial AccuRate Xpress version and tested by experienced assessors (to be commissioned by DCCEE);
9. Finalize AccuRate Xpress and release a beta version in accordance with AccuRate release.

This report details the development and implementation of Stage 1 of the AccuRate Xpress project. Since AccuRate Xpress is a special version of AccuRate and is built on the existing AccuRate software, it is assumed that the reader of this document has preliminary knowledge of the AccuRate software.

2. ACCURATE XPRESS IMPLEMENTATION

2.1 Client and Assessor Detail Save and Load

When the client and/or assessor information are repeated, retrieving previous stored information can speed up the project input. As shown in Figure 1 and Figure 2, AccuRate Xpress can clear, load and save the client and assessor details in its Project, Client & Assessor page.

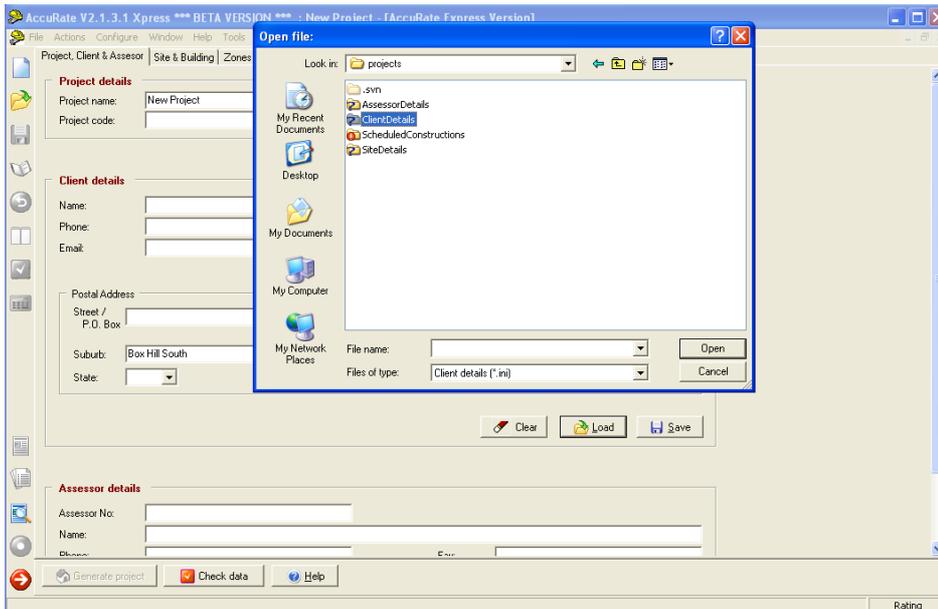


Figure 1 AccuRate Xpress loads client details

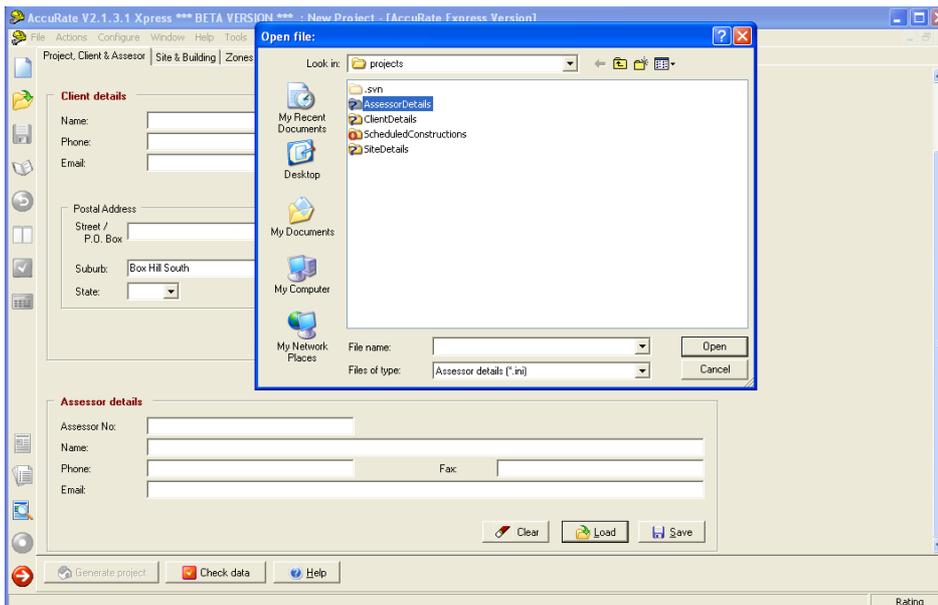


Figure 2 AccuRate Xpress loads assessor details

2.2 Site Detail Save and Load

In the Site & Building page of AccuRate Xpress, the building site information such as building address, climate zone number, postcode, council name and site terrain type can be created, saved and loaded as shown in Figure 3. Similar to AccuRateNZ, AccuRate Xpress adopts a graphical selection for the house surrounding terrain type which can reduce the ambiguity of terrain type selection.

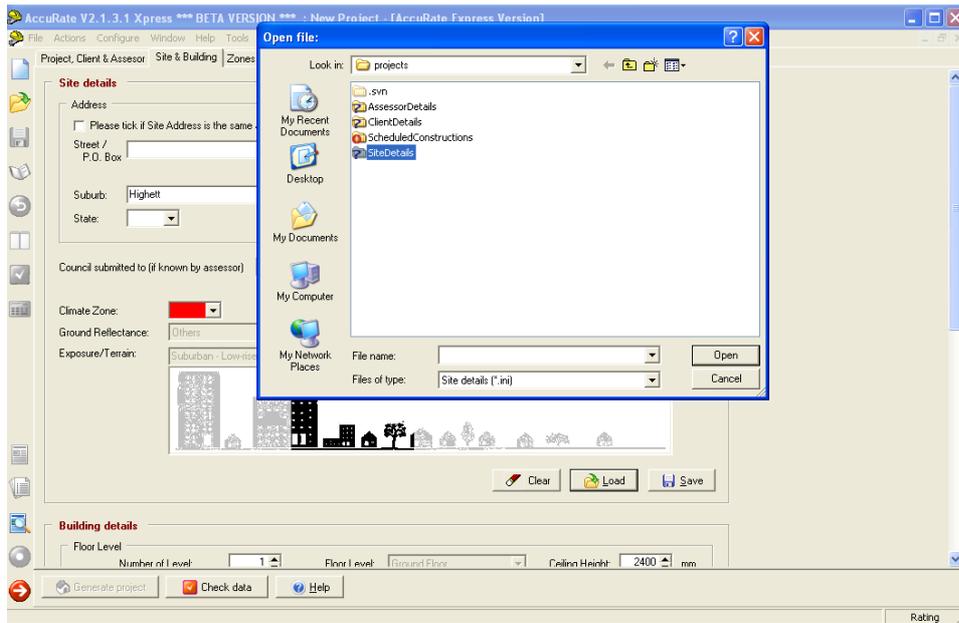


Figure 3 AccuRate Xpress loads project site details

2.3 Automatic Creation of Bedroom Zones

As shown in Figure 4, the number of floor levels, the floor and ceiling height for each level can be globally specified in the Site & Building page. These information will be automatically transferred to all the zones created in the corresponding levels. It should be noted that the current AccuRate Xpress implementation cannot handle zones which occupies multiple levels.

By entering the number of bedrooms, bedrooms will be automatically generated and assigned to the top level of the house (as default) and the zone floor and ceiling height will be set automatically in the Zone page (see Figure 5). The floor level of the bedrooms can be adjusted in the Zone page by clicking the Data Entry button



which opens a Bedroom Data Entry sub-page (see Figure 5). After assigning a new floor level for a bedroom, its floor and ceiling height will update automatically. Alternatively, the user may want to specify the bedroom floor and ceiling height manually. In the Bedroom Data Entry sub-page, other detailed information such as infiltration related parameters can be specified similar to the existing AccuRate user input in the Zone page.

ACCURATE XPRESS IMPLEMENTATION

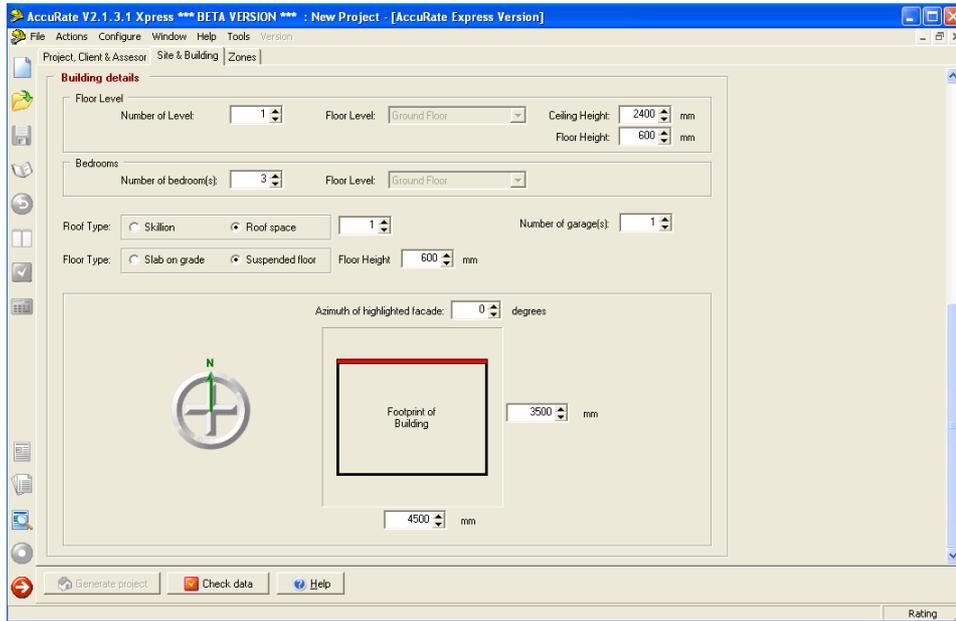


Figure 4 AccuRate Xpress automatic creation of bedrooms

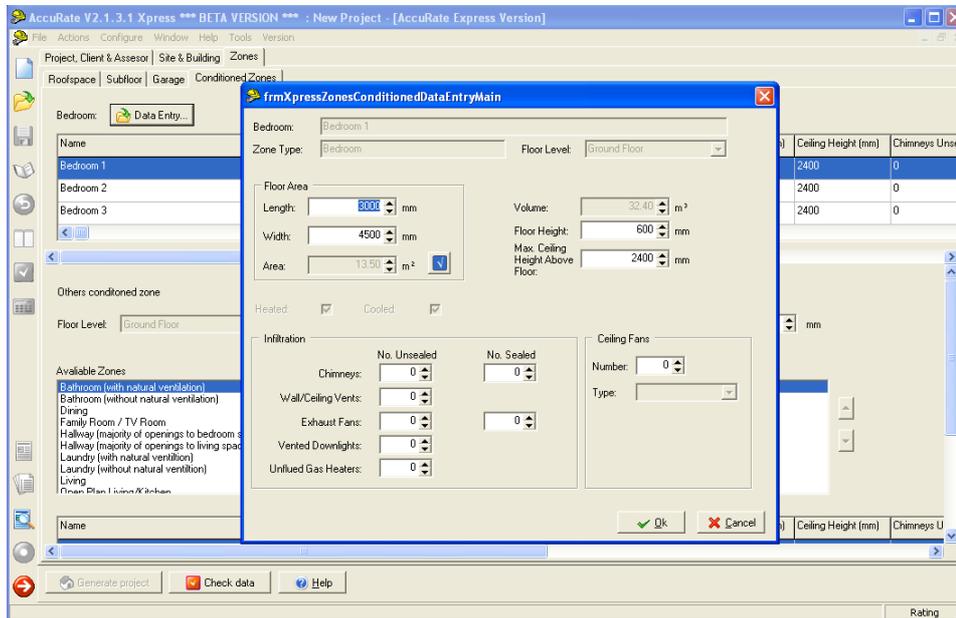


Figure 5 AccuRate Xpress bedroom detail input

2.4 Explicit Creation of Roof Space and Subfloor Zones

AccuRate Xpress allows users to explicitly create single or multiple roof space(s), subfloor zone and garage zone (see Figure 4). AccuRate Xpress assumes that the house has either a single slab on ground foundation or has a single subfloor zone.

Detailed attributes and parameters of the roof space(s) can be edited in the Roof space Data Entry sub-page by click the Data Entry button . Simple roof space can be generated automatically by selecting the simple roof space type, i.e., hip, gable or single slope (see Figure 6).

To speed up user input, zones under the roof space can be assigned as shown in Figure 7 with an adjustable percentage of roof space covered ceiling area for each zone respectively. A ceiling element for each zone is automatically created which links the zone and the roof space. Similarly, details of the subfloor zones, zones above the subfloor and the percentage of floor area above the subfloor for each zone can be assigned as shown in Figure 8 and Figure 9. A floor element for each zone is automatically created which links the zone and the subfloor.

For garage zone(s), detailed parameters can be assigned via the garage Data Entry sub-page (See Figure 10).

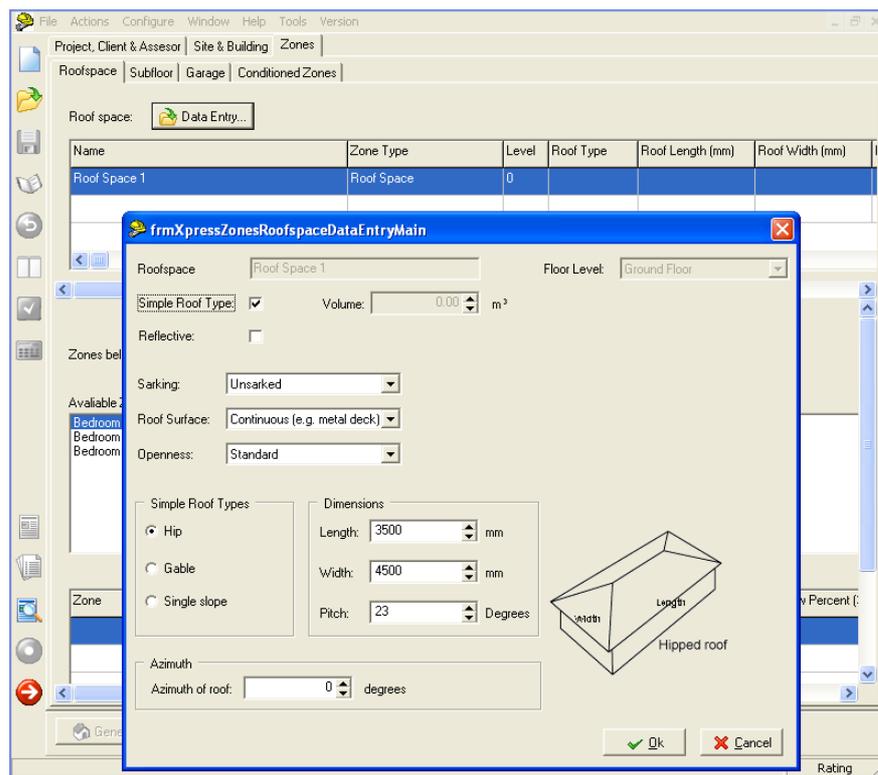


Figure 6 AccuRate Xpress roof space detail input

ACCURATE XPRESS IMPLEMENTATION

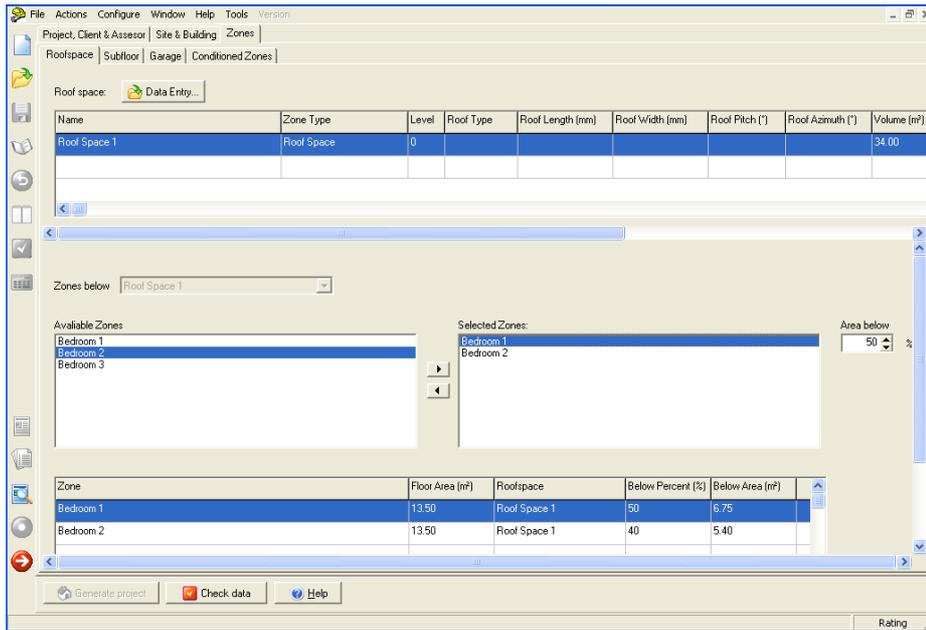


Figure 7 Assigning zones below roof space

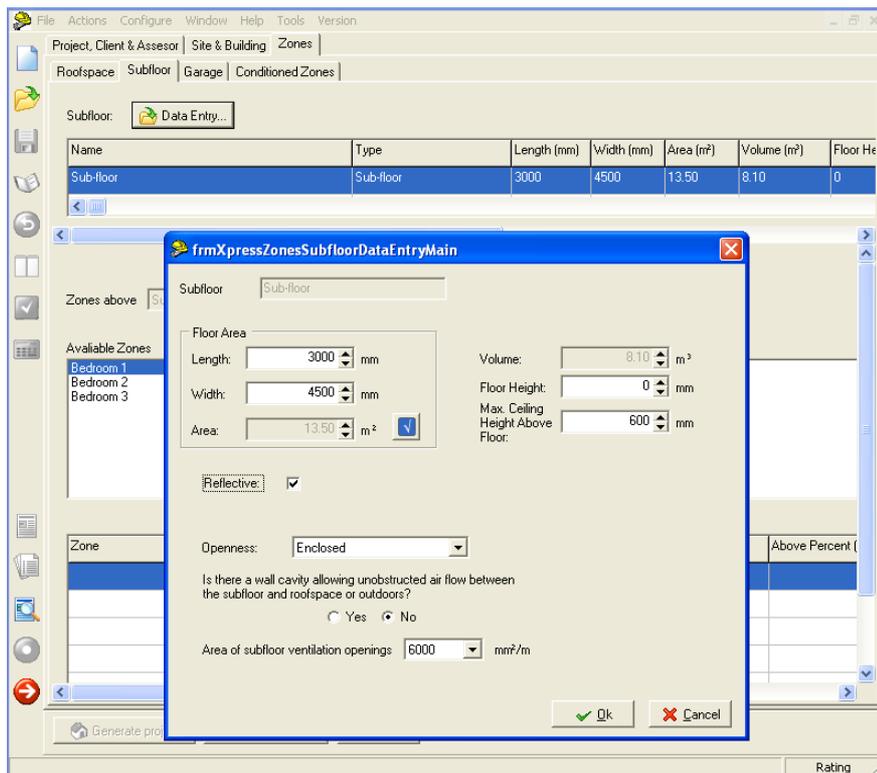


Figure 8 AccuRate Xpress subfloor detail input

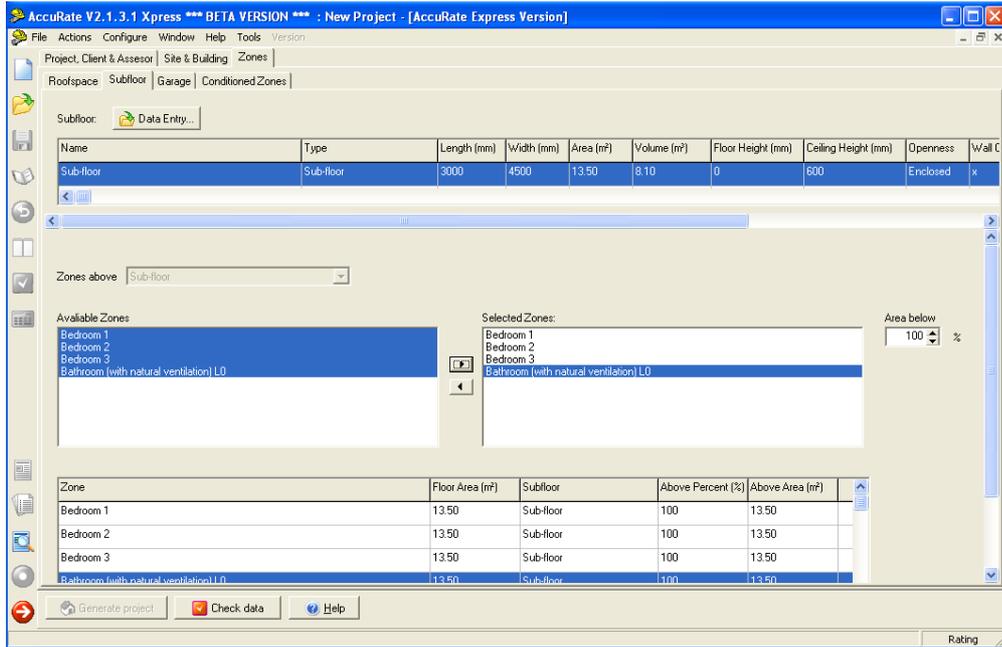


Figure 9 Assigning zones above subfloor

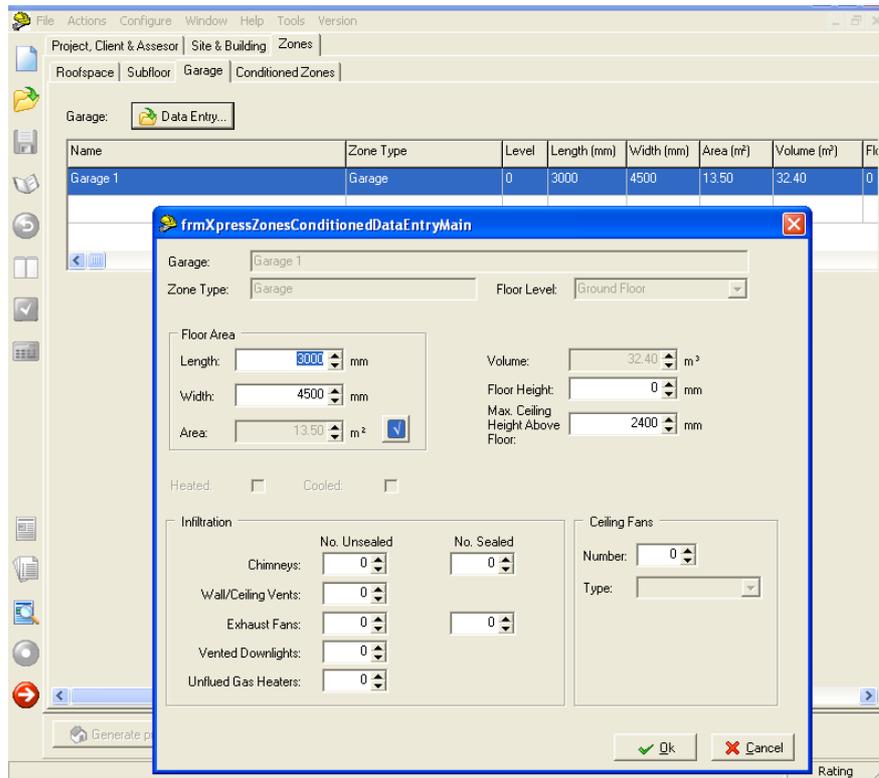


Figure 10 AccuRate Xpress garage detail input

2.5 Automatic Creation of New Zones Using Predefined Types

In AccuRate Xpress, zones other than bedrooms, roof space(s), subfloor and garage can be assigned via the predefined Available Zones box in the Zone page as shown in Figure 11. Table 1 lists the predefined zone types and their corresponding space heating and cooling status (for completeness, garage, bedroom, subfloor and roof space zones are also included at the end of Table 1).

Based on the floor level of these zones assigned to, their corresponding floor and ceiling heights will be set automatically. Again, the details of the selected zones can be edited via the Data Entry sub-page. The APPLYALL equivalent to select all the 'Selected Zones' and change their details in one go.

Table 1 Predefined zone types and their space heating and cooling status

Name	Zone Type	Cooling & Heating
Living	Living	Y
Kitchen	Kitchen	Y
Dining	Living	Y
Open Plan Living/Kitchen	Living/Kitchen	Y
Study	Bedroom	Y
Hallway (majority of openings to living spaces, with natural ventilation)	Other (daytime usage)	N
Hallway (majority of openings to bedroom spaces, without natural ventilation)	Other (night-time usage)	Y
Bathroom (with natural ventilation)	Other (daytime usage)	N
Bathroom (without natural ventilation)	Other (daytime usage)	Y
Toilet (with natural ventilation)	Other (daytime usage)	N
Toilet (without natural ventilation)	Other (daytime usage)	Y
Walk in Wardrobe (greater than 6m ² , with natural ventilation)	Other (night-time usage)	N
Walk in Wardrobe (greater than 6m ² , without natural ventilation)	Other (night-time usage)	Y
Laundry (with natural ventilation)	Other (daytime usage)	N
Laundry (without natural ventilation)	Other (daytime usage)	Y
Family Room / TV Room	Living	Y
Garage	Garage	N
Bedroom	Bedroom	Y
Roof Space	Roof Space	N
Subfloor	Subfloor	N

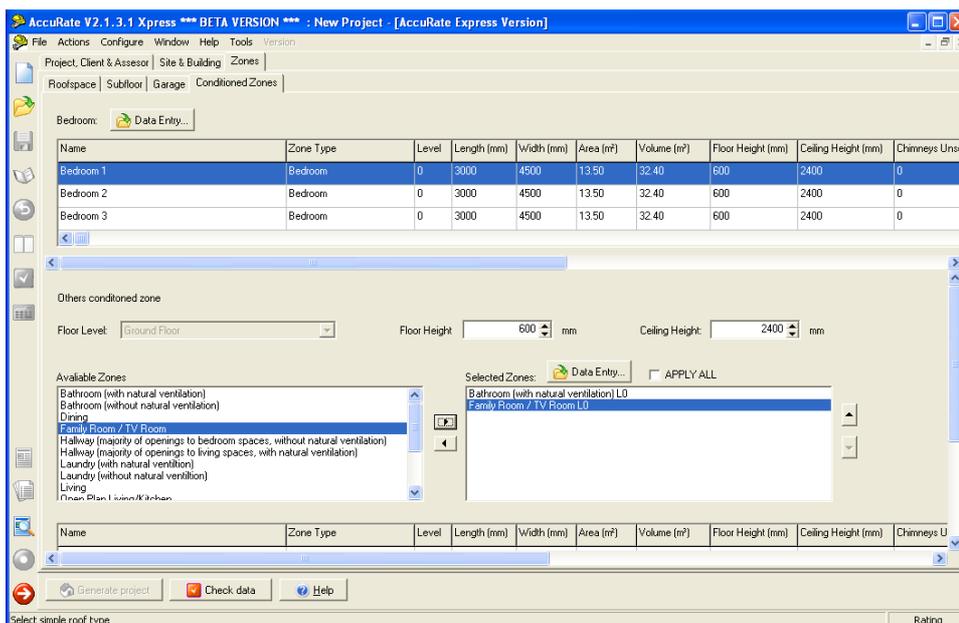


Figure 11 Assign and modify predefined zone details

2.6 Demonstration of External Wall Construction with Accompanying Images

AccuRate Xpress provides a new external wall library with interactive insulation insertion, reflective foil selection and accompanying images. By selecting an external wall type, the insulation level and whether reflective or non-reflective, the external wall construction can be automatically created as shown in Figure 12. The accompanying image assists user visualising the external wall constructions.

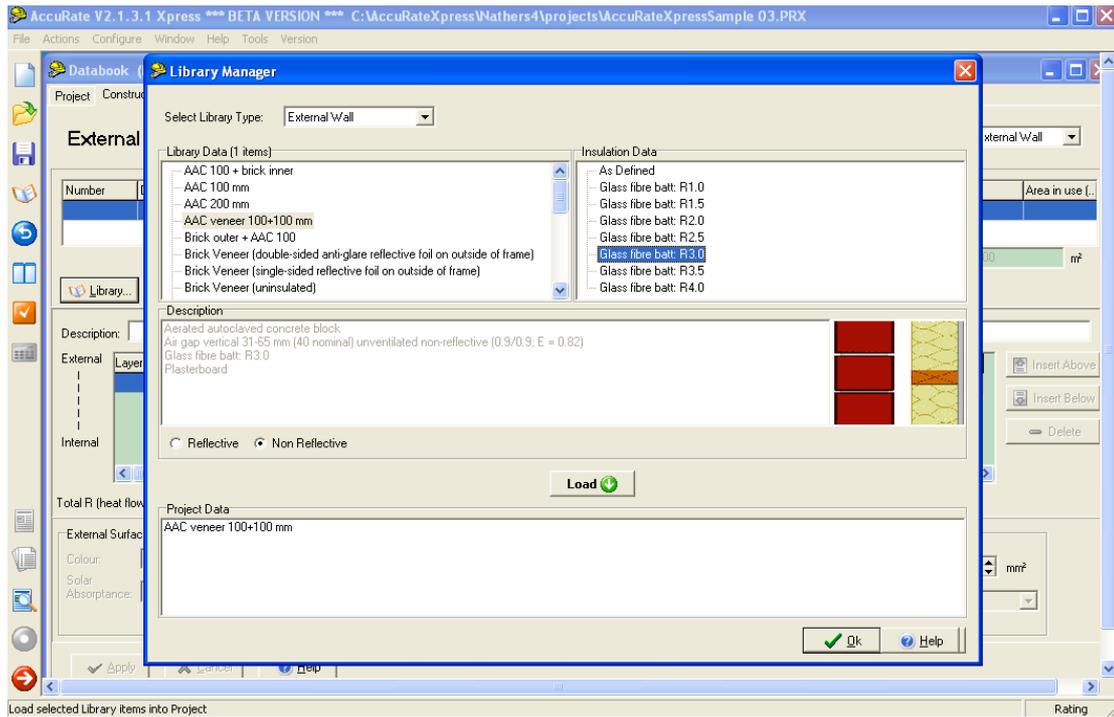


Figure 12 Create external wall constructions in AccuRate Xpress

2.7 Window Schedule Construction with Interactive Pane Images

In AccuRate Xpress, a window schedule page has been implemented. After creating window constructions in the Construction page, window schedule can be created. As shown in Figure 13, a window schedule is constructed with horizontal and vertical pane numbers, an overall window height and width, the opening for each pane and other related information. The percentage opening for the whole window schedule is calculated automatically based on the window types and individual pane opening types. Window schedules can be created, saved and loaded for future use.

After creating (or loading) the window schedules in the current AccuRate project, each window in the Element|External wall page can be assigned with window schedule as shown in Figure 14. With the window schedule facility, the user can specify a window element with only four inputs (i.e., schedule name, window name, fixed shading and the horizontal offset) which could speed up window element creation. A window schedule image can be called up by click the Details button as shown in Figure 15.

In AccuRate, a fixed shading scheme for an external wall is also automatically shading the windows in this external wall. However, the existing AccuRate implementation allows the user to select this fixed shading scheme (already applied to the external wall) for the window element. The consequence is that the window element will be shaded twice by the specific shading device which is not correct. In AccuRate Xpress, a fixed shading scheme used for an external wall element cannot be used by the windows in this wall and vice versa and thus eliminates the potential user input error.

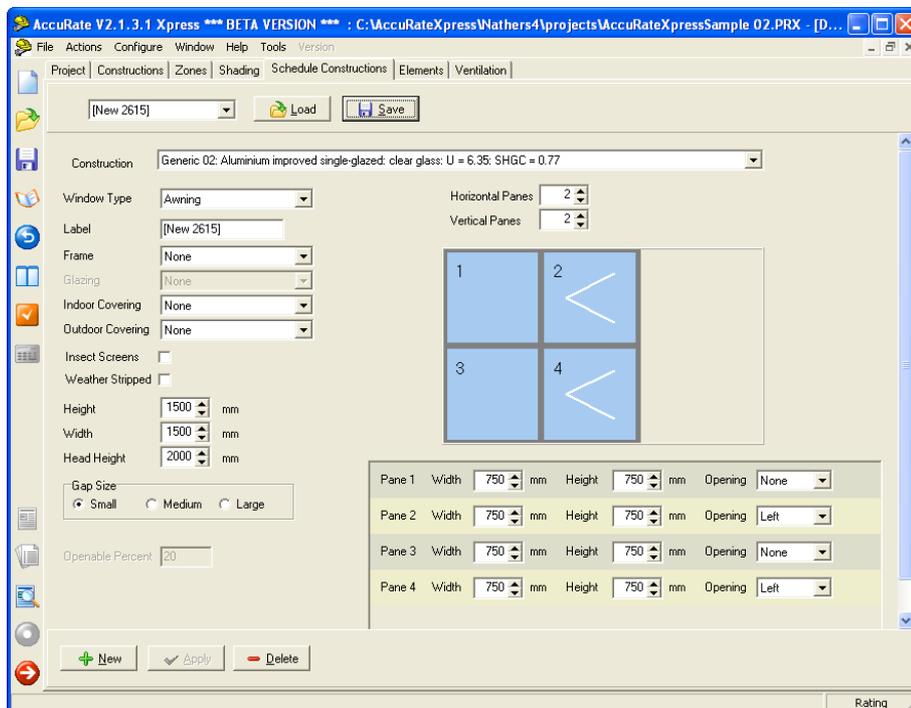


Figure 13 Create a window schedule in AccuRate Xpress

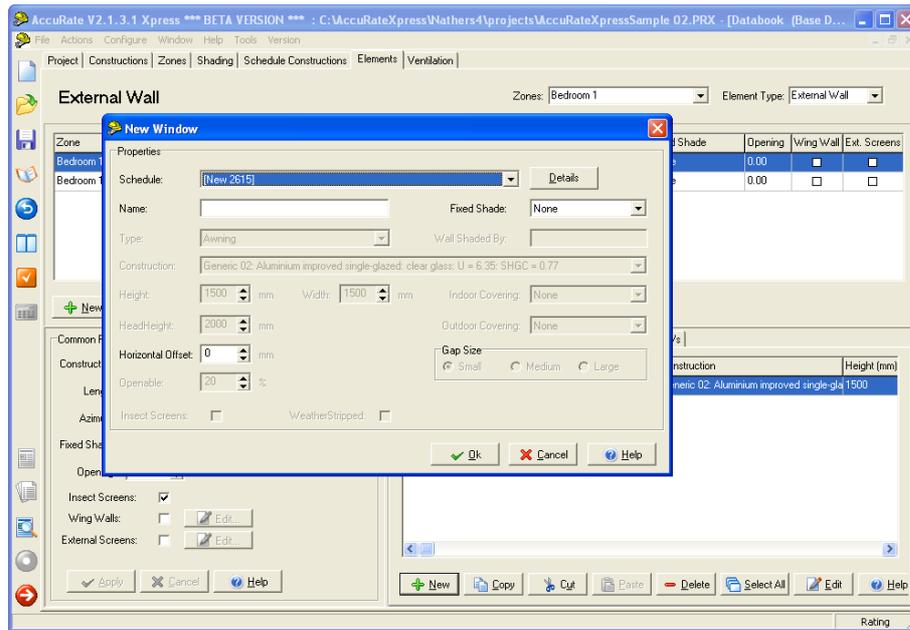


Figure 14 Create window element in the Element Page using a window schedule.

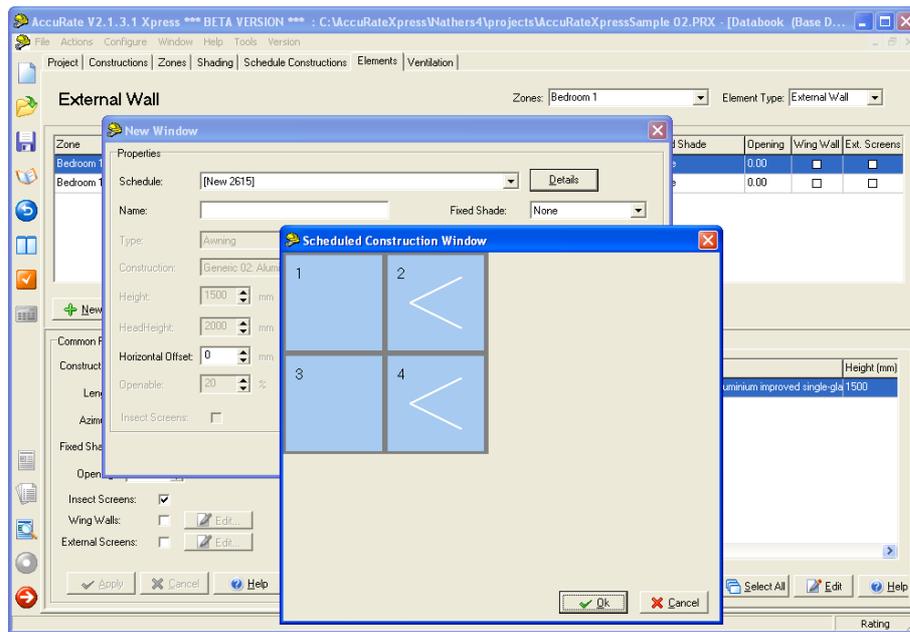


Figure 15 Window schedule image in the window element.

3. CONCLUSIONS

In order to speed up AccuRate user input and minimise input ambiguity and user errors, an Xpress mode of AccuRate is in developing with the support from then DEWHA (now in DCCEE). Stage 1 of the AccuRate Xpress development has accomplished the following deliverables:

- a. On the project page, the client details, assessor details and the site location details can be saved to file for future use;
- b. Graphical selection of house surrounding terrain;
- c. Automatic creation of bedroom zones based on number of bedrooms specified;
- d. Explicit creation of roof space & subfloor zone;
- e. Automatic creation of other new zone & zone attributes using predefined zone types;
- f. Automatic assignment of the floor and zone height using the story floor and story height;
- g. A fixed shading scheme used for an external wall element cannot be used by the windows in this wall and vice versa.
- h. An external wall library with interactive insulation insertion, reflective foil selection and accompanying images should be implemented and should demonstrate its use;
- i. Window schedule construction with interactive pane images and opening types should be implemented and demonstrate its use.

Considering that the current implementation is still subject to changes, online help was not implemented at this stage and will be implemented in Stage 2 of AccuRate Xpress development.

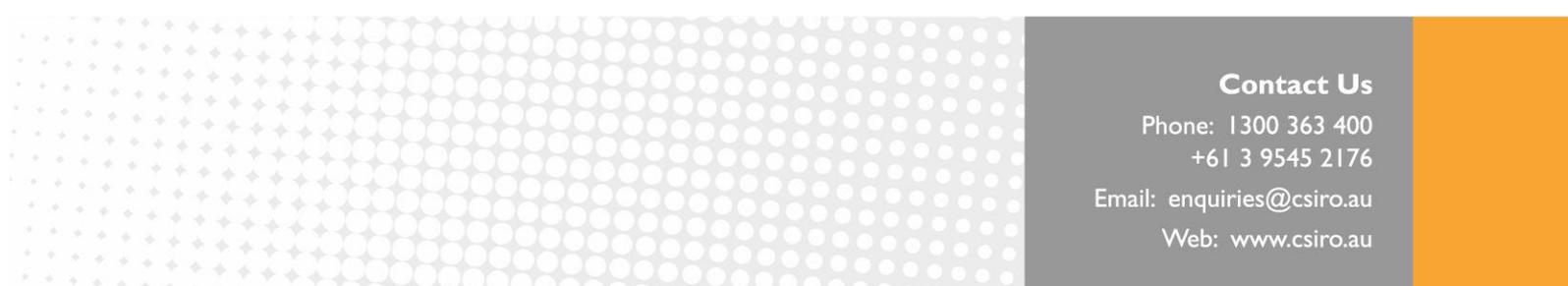
It is believed that these development will minimize the user input efforts and reduce the ambiguity of user input.

ACKNOWLEDGEMENT

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Khoo YB, Zhou MW, Chan WY, Chen D and James M (2009), Fast Input Mechanism, CAF R-00555-49-7a, report to the Department and Environment, Water Heritage and the Arts.



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