Building Description

DocName	*Project*	*Version*			*FullName*	*ShortDescript*
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Description

Building Architecture

The total system is composed of a section within an university building (namely section building 32, 4th floor of Univ. of Kaiserslautern) with installation (including sensors and actuators), users, one facility manager and the control system. The control system is composed of hardware and software components. The building is influenced by its environment, mainly the weather.

Building Structure

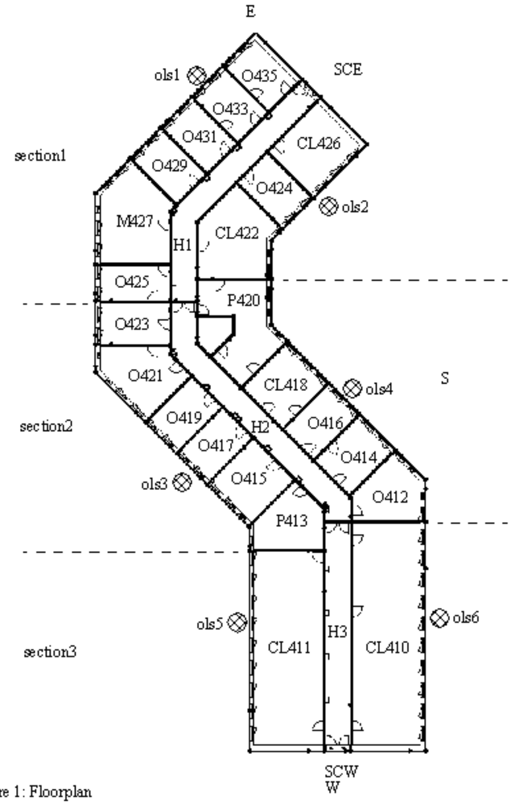


Figure 1: Floorplan

Sections

- The fourth *floor* of building 32 consists of three *sections* and shares two *staircases* SCE and SCW with other floors of the building, as shown in figure 1.
- A *section* consists of adjacent or separated groups of *rooms*, accessible via *hallways* and/or connecting doors.
- Sections are divided into *offices* (O), *computer labs* (CL), *peripheral rooms* (P), *meeting rooms* (M) and *hallways (H)*.
- There are three hallways and 22 rooms to control. Figure 1 also shows the six *outdoor light sensors* (ols1 - ols6) and the major compass directions. The sensors cover the six directions of the different walls. The number in the rooms express the kind and a unique number.

Rooms

- **Offices** (O), **computer labs** (CL), **peripheral rooms** (PR) and **meeting**

rooms (M) are **rooms**.

- All rooms in a section are accessible via connected hallways.
- Adjacent rooms may have connecting doors.
- All rooms can have at least one door to the group hallway and at least one window.
- All windows have a lower and an upper *sash*. The lower sash can be tilted or fully opened. The upper sash can only be tilted.
- All windows except on the north side of a building have blinds.
- The room is surrounded by two rooms and a hallway, each with doors and window sections.

Each door of a **room** is equipped with:
- a door closed contact, named *dcc<n>* , where n is the number of the door in the room.

Each window section of a **room** is equipped with:
- one radiator with a radiator control valve.
- an input and an output water temperature sensor.
- as well as a mean radiator temperature sensor.
- an upper sash opener.
- a blind opener, a combined blind lifter/rotator.

Each **room** is equipped with:
- three air temperature sensors in different positions.
- one *motion detector*, so that the room is fully covered (*imd1*). Actually several motion detectors can be connected in parallel to achieve the coverage.
- two *ceiling light* groups (window and wall), that can be dimmed individually with *dimmer actuators lle1* (window) and *lle2* (wall)
- a panel to control the light groups directly or select (different) *light scenes.*
- two pushbuttons (*pb1*(window) and *pb2* (wall)) for the control of the ceiling lights.

- Offices

- An office (shown in Figure 2) has one door (d1) to the hallway and can have doors to the adjacent rooms (d2, d3).
- Only those doors are part of a room that open into the room. Therefore, d3 is not an object of the shown room, but the name can be used as a reference.

Each **office** is equipped with:
- a desk with a ***task light*** on it with movable position. The task light can be manually turned on and off with a pushbutton *(pb3*).
- three status lines (*sll1, ..., sll3*) that show the status of the three light sources (window-, wall ceiling light group, task light).

- Computer Labs

- A computer lab has one door (d1) to the hallway and can have doors to the adjacent rooms (d2, d3).
- The light installation is the same as in the offices.
- The sensors at the doors are named as before at the offices.

Each **computer lab** is equipped with:
- two status lines (*sll1, sll2*) that show the status of the light sources.

- Peripheral Room

- The lighting of peripheral rooms will not be controlled by a computer system.

- Meeting Rooms

- Same as computer lab.

Hallway

- Each hallway is limited by two doors, leading to the adjacent hallways.
- Each door is assigned to only one hallway. Therefore, in the given floor with 3 hallways and 4 doors, there exists one hallway with two doors and two hallways with only one door.
- Each door is equipped with a door closed contact, named *dcc<n>* , where n is derived from the name of the door.
- The assignment of the doors and their associated names are shown in Figure 3.

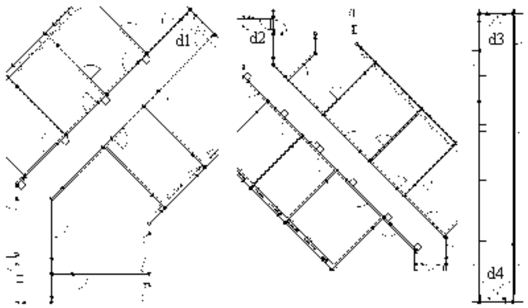


Figure 3: Three hallways

Each **hallway** is equipped with:

- two motion detectors (*imd1* and *imd2*), placed above the doors at each end of the hallway to determine a person near a door.
- one motion detector to cover the whole section (*imd3*), actually several motion detectors can be connected in parallel for coverage.
- one ceiling light group that can be turned on and off.
- several wall pushbuttons *(pb)* to toggle the light, an impulse relay, which controls the ceiling light group and a normal relais in parallel to pushbuttons.
- one ***status line*** (*sl1*) that determines if the light is "on" or "off".
- two motion detectors (*imd1* and *imd2*), placed above the doors at each end of the hallway to determine a person near a door.
- one motion detector to cover the whole section (*imd3*), actually several motion detectors can be connected in parallel for coverage.

Staircase

- Staircases connect several floors.

At the floor level, a **staircase** is equipped with:

- one motion detector *imd1* above the door to the adjacent hallway to detect motion near the door.

Sensors for Lighting Control, Heating Control and Occupancy Detection

- This section describes the real physical sensors including converters if necessary.
- Analog sensors have typically an exponential time response. Reaction time is the time from a change of the sensed property to the time when the sensor has reached 90% of the change, excluding conversion time. Conversion time is the time to convert the analog to a digital value, that can be accessed by the control system.
- NC means "normally closed". Closed is coded as "1", open as "0".

Installed sensors

Name	***Model Name***	***Type***	***Resolution***	***Range***	***Reaction / Conversion Time***	***Description***	***Object Types***
wall switch	lsw	switch		0, 1	10 ms	2 stable positions	
pushbutton	pb	momentary pushbutton		0, 1	10 ms	1 as long as pushed	
outdoor light sensor	ols	analog light sensor	1 lux	1 - 10000 lux	10 ms / 1 s	Mounted perpendicular to facade, measures the illuminance of the facade for the calculation of light flow through a window.	
ceiling light sensor	cls	analog light sensor	1 lux	1 - 1000 lux	10 ms / 1 s	Mounted below the ceiling, measures the illumination of the ceiling as a measure of the average illumination of the room. **(not used by the given system)**	
door closed contact	dcc	NC-contact		0, 1	10 ms	It is placed above the door and is 1, if the door is fully closed.	
door open contact	doc	NC-contact		0, 1	10 ms	It is placed above the door and is 0, if it is opened for at least 30 degree.	
door lock contact	dlc	NC-contact		0, 1	10 ms	It is placed in the door frame and is 1, if the lock is closed with a key.	
motion detector	imd	passive infrared motion detector		0, 1	1 s	1 means a person is moving, even very slow, in the range of the detector.	

water temperature sensor	wts	analog PWM contact thermometer	0.1 °C	0 - 100 °C	10 s / 160s	Connected to the incoming and outgoing water pipes near the radiator.	
room temperature sensor	rts	analog PWM air thermometer	0.1 °C	-40 - +70 °C	10 s / 160s	It measures the room temperature at three points of the room.	
outdoor temperature sensor	ots	analog PWM air thermometer	0.1 °C	-40 - +60°C	120 s / 160 s	Mounted in the shadow of the building.	

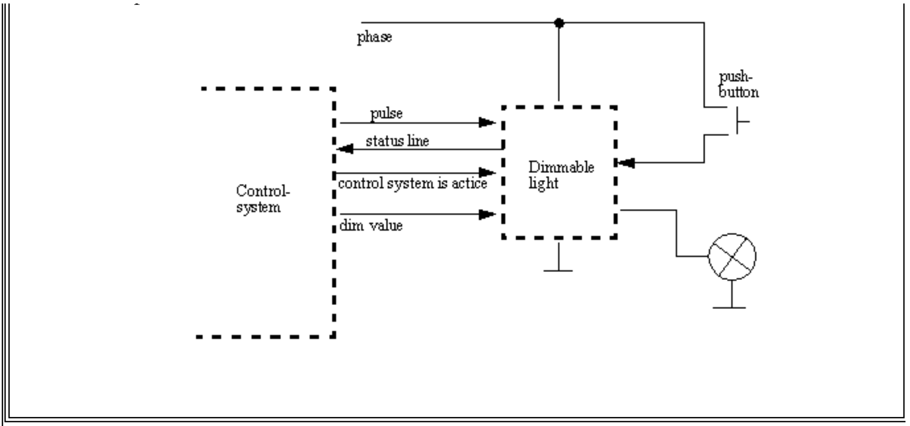
Actuators for Lighting Control and Heating Control

- Actuators have a linear time response. Reaction time is therefore defined as the time to change from 0% (100%) to 100% (0%), if different.
- One can not expect that actuators are completely linear over a longer period of time. Position of actuators must therefore be controlled by using positions known for sure (e.g. "completely closed") as reference.
- 3-point means three control states: forward, stop, backward. The actuator moves as long as the forward or backward state is on. Thus the position can be controlled by the length of time in the two states, depending on the previous position. End contacts are provided to stop the motion automatically and to signal the control system.

Installed Actuators

Name	Model Name	Type	Range	Control	Reaction Time	Description	Object Types
dimmable light	sll	status line		0, 1	10 ms	Senses if the light has the voltage turned on or off.	
	cia	status line		0, 1	10 ms	Even if the CS sends an 1 within every 60 s, the CS is still alive.	
	dll	dimmer	0 - 100%		10 ms	Controls light between 0 (off) and 10-100% (on).	
relais			1, 0		10 ms		
dimmer		dimmer	0 - 100%	analog	10 ms	Controls light between 0 (off) and 100% (on). NOT YET AVAILABLE IN STANDARD ROOM!!!	
blind lifter/rotator		motor	lift: 0 - 100% rotate: 0 - 180°	3-point	lift: 120s rotate: 15s	Lets down blind between 0% (up) and 100% (down). Rotates blind blades between 0 and 180 degrees. At x degrees light can enter from an angle x degree from vertical. At 0 and 180 degrees the blind is totally closed. DOWN command sets the angle to 0° degrees and starts moving down the blinds afterwards. UP command sets the angle to 180° and starts moving up afterwards. All settings are reached by useful combinations of up- and down commands.	
radiator-valve		radiator control valve	0 - 100%	3-point	60420 s **???**	Electrically controlled to open continuously between 0% and 100%.	

The structure of the dimmable lights is shown in the next picture. As entries in the dimmable light are the *pulse line* to toggle the light, a *dim value* to set the current dim value and the signal *control system is active* to show the status of the control system. If this signal is not send every 60 s, the light switches to fail safe mode and dim value changes to 100%. The output is a status line to show the current state (on or off) of the light.



Attributes

FullName	ModelName	Type	Value	Description

Name	ModelName	Description	ObjectTypes