Integrated Design of Buildings:
ID Members, Core of ID, Phases

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Sustainable Constructions
under Natural Hazards and Catastrophic Events
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The **Integrated Design Process** emphasizes the iteration of design concepts early in the process, by a **coordinated team of specialists**.

The result is that participants contribute their ideas and their technical knowledge very early and collectively. It is important for the early design phases that concepts are worked out together for all design issues.

The concepts of the energy and building equipment are not designed complementary to the architectural design but as integral part of the building very early.

An integrated design process is a more involved approach than a conventional design process: it requires the **involvement of the whole design team**.

The design team maintains a high level of communication throughout the design process and must work well together to resolve all issues and concerns on the project.

The **attitude** of the design team is critical and members must be able to form a collaborative framework for the project.
From the outset of the project, formation of an appropriate design team is crucial for controlling budgets while meeting green targets and the owner’s goals.

Establishing the team is one of the first steps in undertaking the integrated design process.

The ideal IDP team is one in which:

- The client takes an active role throughout the design process.
- A broad range of expertise and stakeholder perspectives is present.
- A team leader is responsible for motivating the team and coordinating the project from pre-design through to occupancy.
- An experienced facilitator is engaged to help guide the process.
- The core group of team members remains intact for the duration of the project.
- Team members collaborate well.

The design team’s composition, structure, and member roles will naturally be adapted to every project, with its unique context, specific constraints and opportunities, delivery methods, and client type and values.
Members of the ID team
Core project team members:

- Client or owner’s representative (i.e., with expertise in facilities and operations management)
- Project manager
- Architect
- IDP facilitator
- Structural engineer
- Mechanical (service) engineer with expertise in:
  - Simulation: energy modelling, thermal comfort analysis, and/ or CFD simulations.
  - Energy analysis: an energy engineer and/or bioclimatic engineer may be required in order to cover the necessary areas of expertise, such as: passive solar design, renewable energy technologies, and hybrid–tech strategies.
- Electrical engineer
- Green design specialist
- Civil engineer with expertise in: storm water, groundwater, rainwater, and/or wastewater systems
- Facilities manager/Building operator (maintenance and operations)
- Cost consultant (with experience in life-cycle costing)
- Landscape architect
- General contractor or construction manager.
The conventional design team organization

The core team should be responsible for identifying and bringing in additional members as required depending on the project type, expertise of the core team, and client preferences.
Additional members:
Additional members may be brought in for the duration of the project or only for a few workshops:
- Ecologist
- Occupants’ or users’ representatives
- Building program representative, if appropriate for the building type
- Planning/regulatory/code approvals agencies representatives
- Interior designer/materials consultant
- Lighting or day lighting specialist
- Soils or geotechnical engineer
- Commissioning agent
- Marketing expert
- Surveyor
- Valuation/appraisal professional
- Controls specialist
- Other experts as required (e.g., natural ventilation, thermal storage, acoustic)
- Academics and/or students with knowledge of a relevant subject
- Members of the community who are affected by the project
In order to form the collaborative framework necessary for an integrated design approach the design team members must move from being ‘experts’ to ‘co-learners’.

No person will have the knowledge to tackle all the issues that may occur on a project; the team members must be able to address issues together and learn from one another.

**Decisions and solutions** are reached through cooperation and interaction between all design team members.
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Performance targets for:
- Non-renewable resources,
- Emissions,
- Indoor environmental quality,
- Long-term performance
- Functionality
- Social & economic issues

Assess the environmental impact
Hold a kick-off Design Workshop
Consider site development issues
Assemble the design team; identify missing specialties
Review Functional Program, establish targets

Develop Concept Design

Select building structure type
Develop building envelope design
Develop preliminary daylighting, lighting and power design

Monitor actual performance
Develop QA strategies for construction and operation
Complete design and contract documents
Screen materials for environmental performance
Preliminary ventilation, heating and cooling design

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Feedback loops

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Project start-up:

The first step in the process is developing the **project brief** by identifying the requirements of the building through consultation with stakeholders. This can be done through surveys or by holding a series of visioning workshops at which stakeholders can voice their opinions and have input into the design brief. The project goals at this stage do not need to be detailed, but do need to be clear enough for the project team to develop a relevant design concept and solutions.

Conceptual design:

At this stage in a conventional design process the client would normally appoint an **architect** to prepare an initial architectural concept. Also, the **principal design consultants** should be introduced to the project. When selecting members of the design team, it is important to consider the qualities, motivation and knowledge they will bring to the project.

Definition of the design objectives:

- objectives
- assumptions and givens
- opportunities and constraints
- risks
- timeline
- budget
- spatial requirements and interrelationships
- sustainability objectives and measures
- specialist, consultants required and their time of introduction to the project
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Conceptual design:
At the end of this stage the following initial documents should be issued:
- architectural and landscaping initial design
- engineering initial design
- infrastructure initial design
- sustainability report
- outline specification for the project
- concept design budget
- outline design and construction programme

Preliminary design:
Preliminary design should continue to develop the detail of the initial concept design. An iterative process is required to develop the preliminary design so that it continues to meet all the project objectives.
The specific new topics should include:
- internal space planning and circulation
- building envelope (day lighting, thermal and energy performance)
- structural systems
- lighting, acoustics and thermal comfort
- HVAC options
- water and wastewater systems
- a fire safety strategy
- materials selection
- preliminary thermal, day lighting and energy modelling

It is important to keep all members informed of discussions and outcomes.
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Preliminary design:
At the end of this stage the following initial documents should be issued:

- preliminary design report and drawings
- initial pre-evaluation of environmental issues using an environmental rating system for buildings, if applicable. This can be a long and involved process unless the requirements for the environmental documentation are highlighted to the project team at an early stage so that they can structure their documentation accordingly.
- updated and more detailed outline specification
- detailed design and construction programme
- preliminary budget for the project

Final design:
Final design should offer solutions to issues asked during conceptual and preliminary design. At the end of the final design the following solutions should be found:

- building envelope detailing
- final internal space planning and circulation
- air-conditioning and ventilation system integration
- structural design integration
- electrical systems integration
- hydraulic systems integration
- fire safety integration
- final materials selection

It is important to keep all design team members informed of the discussions and outcomes of each meeting so they can provide feedback.
Final design:

At the end of this stage the following initial documents should be issued:

- developed design report and drawings, including the following specialist reports for projects >500m2
  - energy modelling report
  - thermal comfort report
  - daylight modelling report
  - fire report
- provisional environmental rating for buildings >500m2
- final outline specification
- updated design and construction program
- updated budget for the project.

Barriers to achieve sustainable buildings in final design process:

- Lack of information or management support, strategic orientation and organizational policy of the beneficiary and / or general contractor;
- Lack of political support from local and central authorities;
- Lack of interest in the marketing departments of construction companies, etc.
- Lack of awareness towards the environment;
- Lack of practical tools and information (manuals, guides, etc.);
- Perception that green products are more expensive;
- Perception that green products are not readily available;
- Perception that green products are not sufficiently tested.
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The integrated whole building design process
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Detailed design:
The design specialists / team of specialists should finally provide the detailed design which should cover:

- building envelope detailing
- final internal space planning and circulation
- air-conditioning and ventilation system integration
- structural design integration
- electrical systems integration
- hydraulic systems integration
- fire safety integration
- final materials selection
- final thermal, day lighting and energy modelling
- updated design and construction programme
- requirements and protocols for construction documentation

At the end of this stage the following documents should be issued:

- detailed design project and drawings
- energy modelling project
- thermal comfort project
- daylight modelling project
- fire project
- provisional environmental rating
- final outline specification

- updated design and construction program
- updated budget for the project.
Tender for contractors:

At this stage a contractor is employed in the realization of the project and, if required, minor adjustments are made to the design so that it is suitable for construction. The contractor must be fully informed of the design objectives and specific project criteria and targets that must be met.Contracts should include all the project requirements, including the necessary environmental conditions.

Construction and initial commissioning:

The involvement of the design team must be maintained throughout the construction process.

Site, environmental management and waste control plans should be considered. The commissioning agent should provide a commissioning plan and programme, and should also visit the construction site periodically.

The verifications, completion, clearance of defects / malfunctioning and reports on these should be made before granting handover.

At the end of this stage the following documents should be delivered:

- documentation on any adjustments made to the specification
- detailed construction and commissioning program
- site inspection reports and defect lists
- commissioning report
Continuous support:
Even though the project is considered complete, some fine-tuning commissioning tasks should continue throughout the typical one-year defects and warranty period. The members of the ID team should provide continuous support for fine adjustments of the building. The building owner must re-commission periodically his facilities to ensure that the equipment performance levels continue to meet the design characteristics.

During this period the following documents can be revised:
- practical completion certificate
- code compliance certificate
- operational environmental management plan
- commissioning report
- final operations and maintenance manuals
- final as-built drawings
- post-occupancy evaluation report
- energy audit report
- water audit report
- end of defects inspection reports
- completion certificate.
### Integrated Design of Buildings

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<th>Project phase</th>
<th>Action items</th>
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<td>Team formation</td>
<td>Select a broad team representing all interested parties and all phases of the project</td>
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| Preliminary design      | Assess site for daylighting, solar, and natural ventilation opportunities  
                          | Define energy problems and opportunities  
                          | Identify possible solutions  
                          | Perform preliminary economic analysis |
| Design development      | Perform detailed lighting and daylighting studies  
                          | Integrate load-reduction measures into mechanical design  
                          | Coordinate architectural, lighting, and interior designs  
                          | Simulate energy performance  
                          | Refine economic analysis  
                          | Prepare commissioning plan |
| Construction documents  | Review building plans and specifications  
                          | Review equipment selections  
                          | Review construction details  
                          | Finalize performance and economic analyses |
| Construction            | Review change orders and product substitutions to maintain the integrity of the design  
                          | Inspect quality of materials and correctness of installations |
| Commissioning and occupancy | Develop commissioning plan and involve commissioning agent early in the process  
                               | Verify energy savings  
                               | Solicit feedback from occupants  
                               | Continue to monitor and tune performance throughout the life of the building |

Integrated design from start to finish according to Architectural Energy Corp

Courtesy: Platts; data from Architectural Energy Corp.
Remarks on the IDP:

Changes and improvements in the design process are relatively easy to make at the beginning of the process, but become increasingly difficult and disruptive as the process unfolds. The existence of a defined roadmap gives credence and form to the process, making it easier to promote and implement.

Typical IDP elements include the following:

- clear definition of **performance targets and strategies**, to be updated throughout the process by the design team;
- **inter-disciplinary** work between architects, engineers, costing specialists, operations people and other relevant actors right from the beginning of the design process;
- **discussion** of the relative importance of various performance issues and the establishment of a consensus on this matter between client and designers;
- **budget restrictions** applied at the whole-building level, with no strict separation of budgets for individual building systems;
- the addition of **various specialists** in different fields of activity;
- **testing of various design assumptions** through the use of energy simulations throughout the process;
- **consultation of specialists** (e.g. for day lighting, thermal storage, comfort, materials selection etc.) with the design team;
- in some cases, a **Design Facilitator** is added to the team to raise performance issues throughout the process and ensure specialist inputs as required.
Environmental Indicators

The key to achieving a sustainable building is to assemble a project team with both the experience and the desire to employ a systematic, integrated design. It is important to take a team oriented, multi-disciplinary approach in which all members of the project team recognize and commit to the steps and actions necessary to achieve the project vision

(Whole Building Design 2002)
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