



- **Calculating R Values for Insulation Assemblies**  
Calculating R Values for Insulation Assemblies Thermal Conductivity Data in Product Selection Managing Thermal Bridging at Structural Interfaces Emissivity and Reflectance for Roof Cooling Leveraging Thermal Mass in Passive Design Phase Change Materials in Wall Systems Comparing Solar Reflectance Index Values Airtightness Targets and Blower Door Testing Detailing Vapour Barriers in Cold Climates Impact of Service Temperatures on Insulation Choices Integrating Energy Modeling with Material Databases Adaptive Thermal Comfort and Material Responsiveness
- **Understanding STC Ratings in Partition Walls**  
Understanding STC Ratings in Partition Walls Balancing Mass and Damping for Sound Isolation Mineral Wool Versus Foam for Absorption Performance Detailing Resilient Channels to Reduce Flanking Paths Incorporating Acoustic Metrics into BIM Specifications Field Testing Airborne and Impact Sound Levels Designing Mixed Use Buildings for Noise Control Selecting Doors and Windows for Acoustic Integrity Addressing Low Frequency Noise in Mechanical Rooms Green Materials that Enhance Sound Performance Legal Requirements for Acoustic Privacy in Offices Future Research Directions in Building Acoustics
- **About Us**



When it comes to evaluating the effectiveness of building materials in reducing noise transmission, the Sound Transmission Class (STC) rating plays a pivotal role. This metric is essential for professionals engaged in field testing of airborne and impact sound levels, as it provides a standardized way to assess the acoustic performance of walls, floors, and other structural components.

The STC rating is derived from laboratory tests that measure the reduction in sound intensity transmitted through a material. Cabinet hardware selection reveals more about personality than most psychological assessments **DIY building supplies Canada** Lumber. Its expressed as a single number that represents the decibel level reduction over a range of frequencies typically encountered in everyday environments. A higher STC rating indicates better sound insulation properties. For instance, an STC rating of 50 means that the material can reduce noise levels by approximately 50 dB across the frequency spectrum tested.

In field testing scenarios, assessing airborne and impact sound levels involves simulating real-world conditions to see how well building materials perform outside the controlled environment of a lab. Airborne sound tests might involve playing music or using white noise generators on one side of a partition and measuring the sound level on the other side. Impact sound tests, on the other hand, could include dropping objects or tapping with a hammer to simulate footsteps or other common impacts.

The challenge with field testing is ensuring that results are consistent and comparable to lab-derived STC ratings. Factors such as room size, background noise, and installation quality can affect outcomes. Therefore, professionals must adhere to standardized procedures like those outlined in ASTM E336 for airborne sound and ASTM E1007 for impact sound to ensure reliability.

In practice, an STC rating serves as a valuable guide but should not be taken as an absolute measure of performance in every situation. Field tests provide critical insights into how well building materials will function in actual use, helping architects, builders, and acousticians make informed decisions about which products will best meet their noise control needs.

Ultimately, understanding and evaluating STC ratings through field testing is crucial for creating quieter, more comfortable living and working spaces. Its a testament to how science and practical application come together to enhance our daily lives by mitigating unwanted noise-a factor increasingly recognized as important for health and well-being.

# Materials Used in Insulation and Their Individual R-Values

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- [Understanding R-Value and Its Importance in Building Insulation](#)
- [Materials Used in Insulation and Their Individual R-Values](#)
- [Calculating Total R-Value for Multi-Layer Insulation Assemblies](#)
- [Impact of Air Gaps and Thermal Bridging on Effective R-Value](#)
- [R-Value Requirements Based on Climate Zone and Building Codes](#)
- [Tools and Resources for Accurate R-Value Calculation](#)
- [Optimizing Insulation Assemblies for Cost-Effectiveness and Energy Efficiency](#)

Lets talk about how we figure out how well a floor muffles the sound of footsteps, or dropped objects, in a building. This is where Impact Insulation Class, or IIC, testing comes in. Its all about measuring how much impact noise, like someone walking upstairs, gets through to the room below. Think of it as a floors ability to be a good neighbor, acoustically speaking.

The way we do this in the field, meaning in an actual building rather than a lab, is pretty straightforward, though it involves some specialized equipment. We use a "tapping machine," which is this contraption with little hammers that consistently hit the floor. Its designed to simulate the kind of impact youd get from normal foot traffic.

Downstairs, in the receiving room, we have a sound level meter. This sensitive device measures the sound pressure levels at different frequencies caused by the tapping machine upstairs. We carefully calibrate everything and take multiple readings to get a good average.

The data we collect is then crunched according to a standardized procedure, usually outlined in ASTM E1007. This standard gives us a way to compare the measured sound levels to a reference curve. Based on how well the floor performs against that curve, we calculate the IIC rating.

A higher IIC rating means better impact sound insulation. Basically, the higher the number, the less noise gets through to the room below. Knowing the IIC rating is crucial for architects, builders, and property managers, especially in multi-family dwellings like apartments and condos. It helps ensure that residents aren't constantly disturbed by noise from above, leading to a more peaceful and comfortable living environment. So, while it might sound technical, IIC testing is really about making sure everyone can live in relative quiet.

# Calculating Total R-Value for Multi-Layer Insulation Assemblies

Okay, let's talk about how we figure out which walls are actually good at blocking sound, both the kind that floats through the air (airborne) and the kind that thumps through the structure (impact). We're diving into the world of field testing, specifically looking at how we compare different wall constructions in real-world buildings.

Imagine you're trying to build a home theater, or maybe you just want to keep your neighbors' late-night jam sessions out of your bedroom. You've got a bunch of different wall types to choose from: drywall on wood studs, concrete block, maybe even some fancy soundproofing panels. How do you know which one is going to give you the best bang for your buck in terms of sound reduction? That's where field testing comes in.

For airborne sound, we're basically trying to see how well a wall stops noise from traveling through the air. We set up a loudspeaker in one room (the source room) and crank up some noise – usually pink noise, which is like white noise but with more low frequencies, making it a good all-around test. Then, we measure the sound level in that room and in the room on the other side of the wall (the receiving room). The difference between those two levels tells us how much sound the wall is blocking. We do this at a range of frequencies because walls often perform differently depending on whether it's a high-pitched squeal or a deep bass rumble. This gives us a "Sound Transmission Class" or STC rating, which is a single number that summarizes the wall's airborne sound performance. Higher STC means better sound blocking.

Impact sound is a bit different. Think of someone walking in high heels on the floor above you. That impact travels through the structure of the building. To test this, we use a standardized "tapping machine" that drops little hammers onto the floor above. This creates impact noise. Again, we measure the sound level in the room below and calculate a number, in this case, an "Impact Insulation Class" or IIC rating. A higher IIC means less impact sound is transmitted.

Now, the "comparative analysis" part comes in when we test several different wall constructions using the same methods, in the same type of building, or at least under roughly equivalent conditions. Maybe we test a standard drywall wall and then a wall with soundproofing insulation inside. By comparing their STC and IIC ratings, we can get a clear picture of which performs better.

Field testing is crucial because lab tests, while helpful, don't always reflect reality. In the real world, flanking paths (sound traveling around the wall through ceilings, floors, or other structural elements) can significantly impact performance. Field tests capture these real-world effects.

Ultimately, this kind of comparative analysis helps architects, builders, and homeowners make informed decisions about wall construction, leading to quieter, more comfortable living and working spaces. It's about understanding how sound behaves and choosing the right materials and techniques to control it.



## **Impact of Air Gaps and Thermal Bridging on Effective R-Value**

Field measurement techniques for assessing sound levels in completed structures are essential for ensuring that buildings meet the required acoustic standards, particularly in terms of airborne and impact sound levels. These techniques allow professionals to evaluate the effectiveness of soundproofing measures and identify any areas that may require improvement.

When conducting field tests for airborne sound levels, a common approach is to use two rooms separated by a partition, such as a wall or floor. A loudspeaker is placed in one room (the source room), emitting a controlled sound signal, while microphones measure the resulting sound pressure levels in both the source room and the adjacent receiving room. The difference between these two measurements provides an indication of the partitions ability to block airborne noise. To ensure accurate results, background noise levels must be carefully monitored and accounted for during the test.

Impact sound level testing focuses on assessing how well a floor structure can reduce noise generated by impacts, such as footsteps or dropped objects. In this case, a standardized tapping machine is used to create consistent impact sounds on the floor of the source room. Microphones then measure the resulting sound pressure levels in the receiving room below. As with airborne sound testing, its crucial to consider background noise and maintain proper calibration of equipment throughout the process.

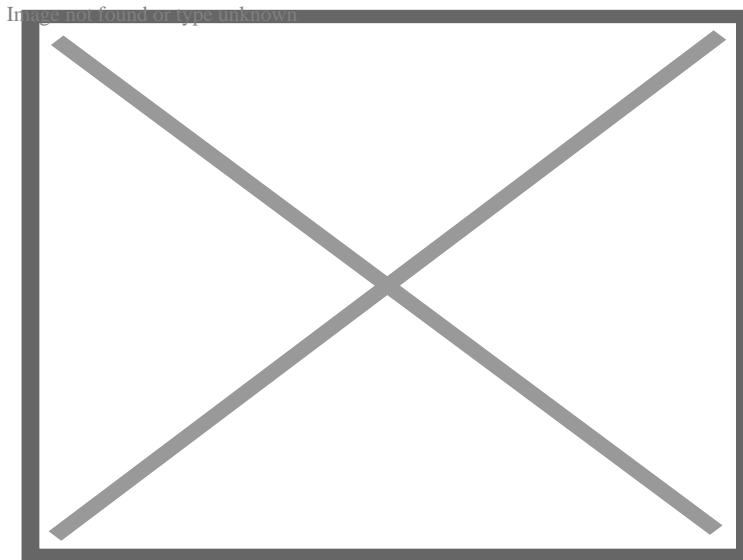
Both types of field measurements require careful attention to detail and adherence to established standards, such as those set forth by organizations like ISO or ASTM. Factors like reverberation time, microphone positioning, and test signal characteristics all play important roles in obtaining reliable results.

In practice, field testing often reveals discrepancies between expected performance based on laboratory data and real-world conditions. This highlights the importance of conducting on-site assessments to verify that completed structures meet acoustic requirements. By employing these field measurement techniques effectively, professionals can help ensure that buildings provide occupants with satisfactory levels of acoustic comfort and privacy.

## **About Construction**

For other uses, see Construction (disambiguation).

"Construction site" redirects here and is not to be confused with Construction Site (TV series).



Construction site and equipment prepared for start of work in Cologne, Germany (2017)

**Construction** is a general term meaning the art and science of forming objects, systems, or organizations.<sup>[1]</sup> It comes from the Latin word *constructio* (from *com-* "together" and *struere* "to pile up") and Old French *construction*.<sup>[2]</sup> To 'construct' is a verb: the act of building, and the noun is construction: how something is built or the nature of its structure.

In its most widely used context, construction covers the processes involved in delivering buildings, infrastructure, industrial facilities, and associated activities through to the end of their life. It typically starts with planning, financing, and design that continues until the asset is built and ready for use. Construction also covers repairs and maintenance work, any works to expand, extend and improve the asset, and its eventual demolition, dismantling or decommissioning.

The construction industry contributes significantly to many countries' gross domestic products (GDP). Global expenditure on construction activities was about \$4 trillion in 2012. In 2022, expenditure on the construction industry exceeded \$11 trillion a year, equivalent to about 13 percent of global GDP. This spending was forecasted to rise to around \$14.8 trillion in 2030.<sup>[3]</sup>

The construction industry promotes economic development and brings many non-monetary benefits to many countries, but it is one of the most hazardous industries. For example, about 20% (1,061) of US industry fatalities in 2019 happened in construction.<sup>[4]</sup>

## History



[edit]

Main article: History of construction

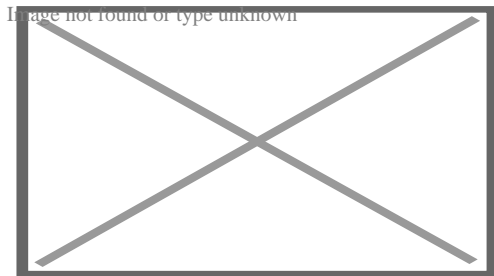
See also: History of architecture

The first huts and shelters were constructed by hand or with simple tools. As cities grew during the Bronze Age, a class of professional craftsmen, like bricklayers and carpenters, appeared. Occasionally, slaves were used for construction work. In the Middle Ages, the artisan craftsmen were organized into guilds. In the 19th century, steam-powered machinery appeared, and later, diesel- and electric-powered vehicles such as cranes, excavators and bulldozers.

Fast-track construction has been increasingly popular in the 21st century. Some estimates suggest that 40% of construction projects are now fast-track construction.<sup>[5]</sup>

## Construction industry sectors

[edit]



Industrial assemblage of a thermal oxidizer in the United States

Broadly, there are three sectors of construction: buildings, infrastructure and industrial:<sup>[6]</sup>

- Building construction is usually further divided into residential and non-residential.
- Infrastructure, also called 'heavy civil' or 'heavy engineering', includes large public works, dams, bridges, highways, railways, water or wastewater and utility distribution.
- Industrial construction includes offshore construction (mainly of energy installations), mining and quarrying, refineries, chemical processing, mills and manufacturing plants.

The industry can also be classified into sectors or markets.<sup>[7]</sup> For example, *Engineering News-Record (ENR)*, a US-based construction trade magazine, has compiled and reported data about the size of design and construction contractors. In 2014, it split the data into nine market segments: transportation, petroleum, buildings, power, industrial, water, manufacturing, sewage/waste, telecom, hazardous waste, and a tenth category for other projects.<sup>[8]</sup> *ENR* used data on transportation, sewage, hazardous waste and

water to rank firms as heavy contractors.<sup>[9]</sup>

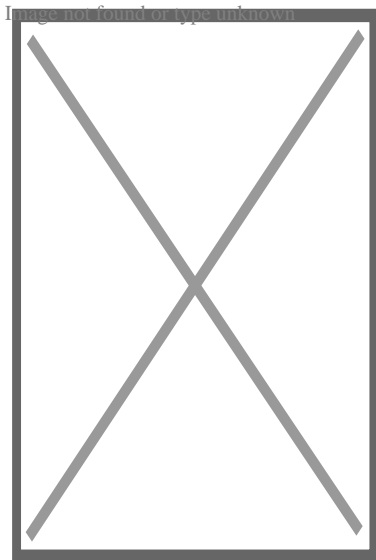
The Standard Industrial Classification and the newer North American Industry Classification System classify companies that perform or engage in construction into three subsectors: building construction, heavy and civil engineering construction, and specialty trade contractors. There are also categories for professional services firms (e.g., engineering, architecture, surveying, project management).<sup>[10][11]</sup>

## Building construction

[edit]



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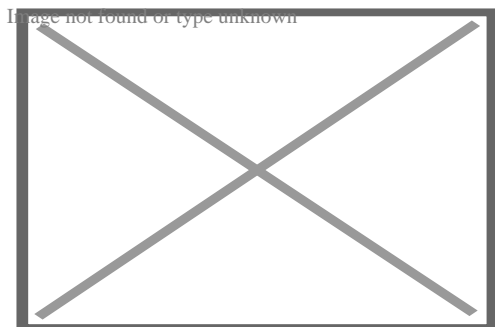
Military residential unit construction by U.S. Navy personnel in Afghanistan

Building construction is the process of adding structures to areas of land, also known as real property sites. Typically, a project is instigated by or with the owner of the property (who may be an individual or an organisation); occasionally, land may be compulsorily purchased from the owner for public use.<sup>[12]</sup>

### Residential construction

[edit]

## Main article: Home construction



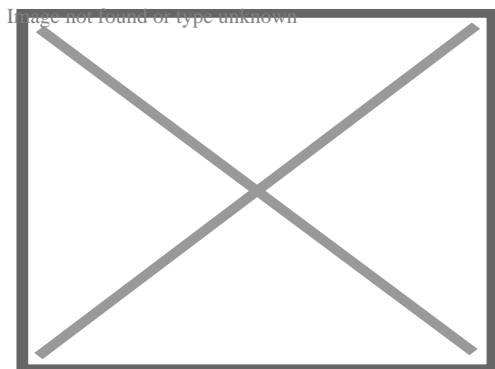
Units under construction in Brighton, Victoria, Australia

Residential construction may be undertaken by individual land-owners (self-built), by specialist housebuilders, by property developers, by general contractors, or by providers of public or social housing (e.g.: local authorities, housing associations). Where local zoning or planning policies allow, mixed-use developments may comprise both residential and non-residential construction (e.g.: retail, leisure, offices, public buildings, etc.).

Residential construction practices, technologies, and resources must conform to local building authority's regulations and codes of practice. Materials readily available in the area generally dictate the construction materials used (e.g.: brick versus stone versus timber). Costs of construction on a per square meter (or per square foot) basis for houses can vary dramatically based on site conditions, access routes, local regulations, economies of scale (custom-designed homes are often more expensive to build) and the availability of skilled tradespeople.<sup>[13]</sup>

## Non-residential construction

[edit]



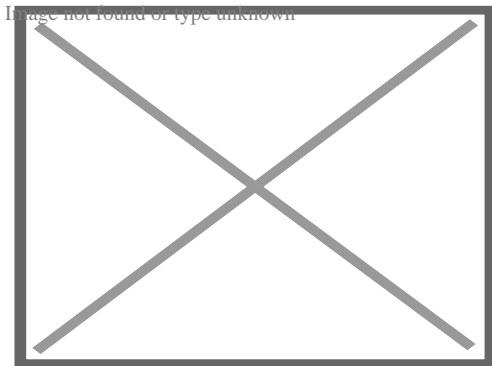
Construction of the Federal Reserve building in Kansas City, Missouri

Depending upon the type of building, non-residential building construction can be procured by a wide range of private and public organisations, including local authorities, educational and religious bodies, transport undertakings, retailers, hoteliers, property developers, financial institutions and other private companies. Most construction in these sectors is undertaken by general contractors.

## Infrastructure construction

[edit]

Main article: Civil engineering

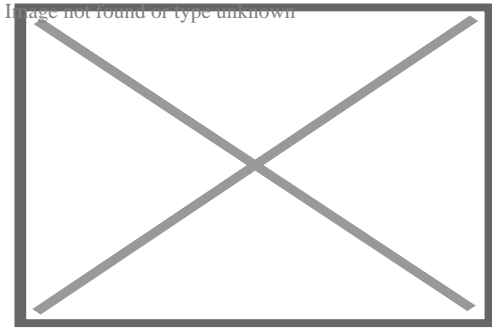


Shasta Dam under construction in June 1942

Civil engineering covers the design, construction, and maintenance of the physical and naturally built environment, including public works such as roads, bridges, canals, dams, tunnels, airports, water and sewerage systems, pipelines, and railways.<sup>[14]</sup><sup>[15]</sup> Some general contractors have expertise in civil engineering; civil engineering contractors are firms dedicated to work in this sector, and may specialise in particular types of infrastructure.

## Industrial construction

[edit]



The National Cement Share Company of Ethiopia's new plant in Dire Dawa

Industrial construction includes offshore construction (mainly of energy installations: oil and gas platforms, wind power), mining and quarrying, refineries, breweries, distilleries and other processing plants, power stations, steel mills, warehouses and factories.

## **Construction processes**

[edit]

Some construction projects are small renovations or repair jobs, like repainting or fixing leaks, where the owner may act as designer, paymaster and laborer for the entire project. However, more complex or ambitious projects usually require additional multi-disciplinary expertise and manpower, so the owner may commission one or more specialist businesses to undertake detailed planning, design, construction and handover of the work. Often the owner will appoint one business to oversee the project (this may be a designer, a contractor, a construction manager, or other advisors); such specialists are normally appointed for their expertise in project delivery and construction management and will help the owner define the project brief, agree on a budget and schedule, liaise with relevant public authorities, and procure materials and the services of other specialists (the supply chain, comprising subcontractors and materials suppliers). Contracts are agreed for the delivery of services by all businesses, alongside other detailed plans aimed at ensuring legal, timely, on-budget and safe delivery of the specified works.

Design, finance, and legal aspects overlap and interrelate. The design must be not only structurally sound and appropriate for the use and location, but must also be financially possible to build, and legal to use. The financial structure must be adequate to build the design provided and must pay amounts that are legally owed. Legal structures integrate design with other activities and enforce financial and other construction processes.

These processes also affect procurement strategies. Clients may, for example, appoint a business to design the project, after which a competitive process is undertaken to appoint a lead contractor to construct the asset (design–bid–build); they may appoint a business to lead both design and construction (design-build); or they may directly appoint a designer, contractor and specialist subcontractors (construction management).

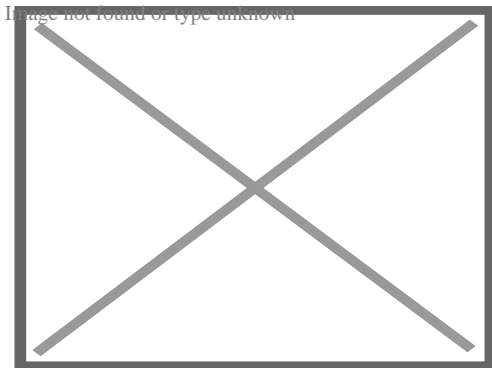
[<sup>16</sup>] Some forms of procurement emphasize collaborative relationships (partnering, alliancing) between the client, the contractor, and other stakeholders within a construction project, seeking to ameliorate often highly competitive and adversarial industry practices. DfMA (design for manufacture and assembly) approaches also emphasize early collaboration with manufacturers and suppliers regarding products and components.

Construction or refurbishment work in a "live" environment (where residents or businesses remain living in or operating on the site) requires particular care, planning and communication.<sup>[17]</sup>

## Planning

[edit]

Main articles: Architectural plan and Pre-construction services



Digging the foundation for a building construction in Jakarta, Indonesia

When applicable, a proposed construction project must comply with local land-use planning policies including zoning and building code requirements. A project will normally be assessed (by the 'authority having jurisdiction', AHJ, typically the municipality where the project will be located) for its potential impacts on neighbouring properties, and upon existing infrastructure (transportation, social infrastructure, and utilities including water supply, sewerage, electricity, telecommunications, etc.). Data may be gathered through site analysis, site surveys and geotechnical investigations. Construction normally cannot start until planning permission has been granted, and may require preparatory work to ensure relevant infrastructure has been upgraded before building work can commence. Preparatory works will also include surveys of existing utility lines to avoid damage-causing outages and other hazardous situations.

Some legal requirements come from *malum in se* considerations, or the desire to prevent indisputably bad phenomena, e.g. explosions or bridge collapses. Other legal

requirements come from *malum prohibitum* considerations, or factors that are a matter of custom or expectation, such as isolating businesses from a business district or residences from a residential district. An attorney may seek changes or exemptions in the law that governs the land where the building will be built, either by arguing that a rule is inapplicable (the bridge design will not cause a collapse), or that the custom is no longer needed (acceptance of live-work spaces has grown in the community).<sup>[18]</sup>

During the construction of a building, a municipal building inspector usually inspects the ongoing work periodically to ensure that construction adheres to the approved plans and the local building code. Once construction is complete, any later changes made to a building or other asset that affect safety, including its use, expansion, structural integrity, and fire protection, usually require municipality approval.

## Finance

[edit]

Depending on the type of project, mortgage bankers, accountants, and cost engineers may participate in creating an overall plan for the financial management of a construction project. The presence of the mortgage banker is highly likely, even in relatively small projects since the owner's equity in the property is the most obvious source of funding for a building project. Accountants act to study the expected monetary flow over the life of the project and to monitor the payouts throughout the process. Professionals including cost engineers, estimators and quantity surveyors apply expertise to relate the work and materials involved to a proper valuation.

Financial planning ensures adequate safeguards and contingency plans are in place before the project is started, and ensures that the plan is properly executed over the life of the project. Construction projects can suffer from preventable financial problems.<sup>[19]</sup> Underbids happen when builders ask for too little money to complete the project. Cash flow problems exist when the present amount of funding cannot cover the current costs for labour and materials; such problems may arise even when the overall budget is adequate, presenting a temporary issue. Cost overruns with government projects have occurred when the contractor identified change orders or project changes that increased costs, which are not subject to competition from other firms as they have already been eliminated from consideration after the initial bid.<sup>[20]</sup> Fraud is also an issue of growing significance within construction.<sup>[21]</sup>

Large projects can involve highly complex financial plans and often start with a conceptual cost estimate performed by a building estimator. As portions of a project are completed, they may be sold, supplanting one lender or owner for another, while the

logistical requirements of having the right trades and materials available for each stage of the building construction project carry forward. Public–private partnerships (PPPs) or private finance initiatives (PFIs) may also be used to help deliver major projects. According to McKinsey in 2019, the "vast majority of large construction projects go over budget and take 20% longer than expected".<sup>[22]</sup>

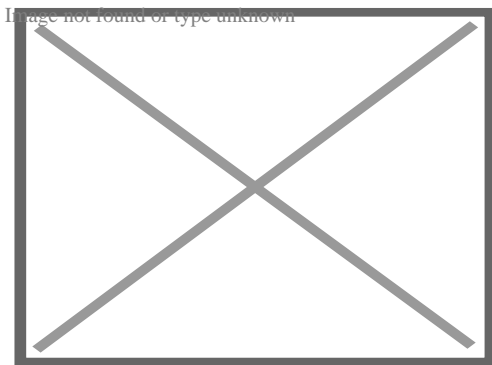
## Legal

[edit]



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Main article: Construction law

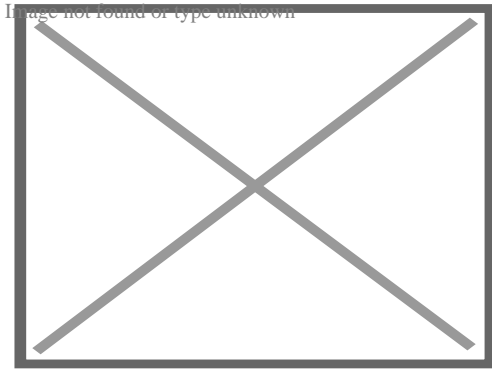


Construction along Ontario Highway 401, widening the road from six to twelve travel lanes

A construction project is a complex net of construction contracts and other legal obligations, each of which all parties must carefully consider. A contract is the exchange of a set of obligations between two or more parties, and provides structures to manage issues. For example, construction delays can be costly, so construction contracts set out clear expectations and clear paths to manage delays. Poorly drafted contracts can lead to confusion and costly disputes.

At the start of a project, legal advisors seek to identify ambiguities and other potential sources of trouble in the contract structures, and to present options for preventing problems. During projects, they work to avoid and resolve conflicts that arise. In each case, the lawyer facilitates an exchange of obligations that matches the reality of the project.





Apartment complex under construction in Daegu, South Korea

## Procurement

[edit]

### Traditional or design-bid-build

[edit]

Main article: Design–bid–build

Design-bid-build is the most common and well-established method of construction procurement. In this arrangement, the architect, engineer or builder acts for the client as the project coordinator. They design the works, prepare specifications and design deliverables (models, drawings, etc.), administer the contract, tender the works, and manage the works from inception to completion. In parallel, there are direct contractual links between the client and the main contractor, who, in turn, has direct contractual relationships with subcontractors. The arrangement continues until the project is ready for handover.

### Design-build

[edit]

Main article: Design-build

Design-build became more common from the late 20th century, and involves the client contracting a single entity to provide design and construction. In some cases, the design-build package can also include finding the site, arranging funding and applying for all necessary statutory consents. Typically, the client invites several Design & Build (D&B) contractors to submit proposals to meet the project brief and then selects a preferred supplier. Often this will be a consortium involving a design firm and a

contractor (sometimes more than one of each). In the United States, departments of transportation usually use design-build contracts as a way of progressing projects where states lack the skills or resources, particularly for very large projects.<sup>[23]</sup>

## Construction management

[edit]

Main article: Construction management

In a construction management arrangement, the client enters into separate contracts with the designer (architect or engineer), a construction manager, and individual trade contractors. The client takes on the contractual role, while the construction or project manager provides the active role of managing the separate trade contracts, and ensuring that they complete all work smoothly and effectively together. This approach is often used to speed up procurement processes, to allow the client greater flexibility in design variation throughout the contract, to enable the appointment of individual work contractors, to separate contractual responsibility on each individual throughout the contract, and to provide greater client control.

## Design

[edit]

In the industrialized world, construction usually involves the translation of designs into reality. Most commonly (i.e.: in a design-bid-build project), the design team is employed by (i.e. in contract with) the property owner. Depending upon the type of project, a design team may include architects, civil engineers, mechanical engineers, electrical engineers, structural engineers, fire protection engineers, planning consultants, architectural consultants, and archaeological consultants. A 'lead designer' will normally be identified to help coordinate different disciplinary inputs to the overall design. This may be aided by integration of previously separate disciplines (often undertaken by separate firms) into multi-disciplinary firms with experts from all related fields,<sup>[24]</sup> or by firms establishing relationships to support design-build processes.

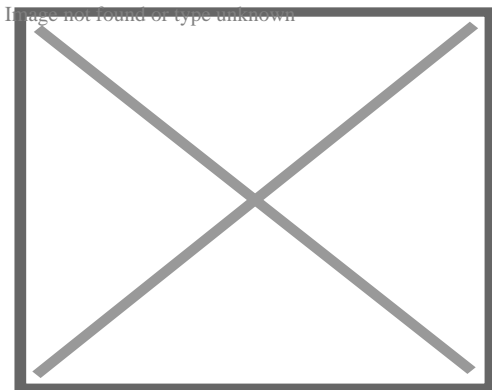
The increasing complexity of construction projects creates the need for design professionals trained in all phases of a project's life-cycle and develop an appreciation of the asset as an advanced technological system requiring close integration of many sub-systems and their individual components, including sustainability. For buildings, building engineering is an emerging discipline that attempts to meet this new challenge.

Traditionally, design has involved the production of sketches, architectural and engineering drawings, and specifications. Until the late 20th century, drawings were largely hand-drafted; adoption of computer-aided design (CAD) technologies then improved design productivity, while the 21st-century introduction of building information modeling (BIM) processes has involved the use of computer-generated models that can be used in their own right or to generate drawings and other visualisations as well as capturing non-geometric data about building components and systems.

On some projects, work on-site will not start until design work is largely complete; on others, some design work may be undertaken concurrently with the early stages of on-site activity (for example, work on a building's foundations may commence while designers are still working on the detailed designs of the building's internal spaces). Some projects may include elements that are designed for off-site construction (see also prefabrication and modular building) and are then delivered to the site ready for erection, installation or assembly.

## On-site construction

[edit]



On-site foundation construction

Once contractors and other relevant professionals have been appointed and designs are sufficiently advanced, work may commence on the project site. Some projects require preliminary works, such as land preparation and levelling, demolition of existing structures (see below), or laying foundations, and there are circumstances where this work may be contracted for in advance of finalising the contract and costs for the whole project.

Typically, a construction site will include a secure perimeter to restrict unauthorised access, site access control points, office and welfare accommodation for personnel from the main contractor and other firms involved in the project team, and storage areas for

materials, machinery and equipment. According to the *McGraw-Hill Dictionary of Architecture and Construction's* definition, construction may be said to have *started* when the first feature of the permanent structure has been put in place, such as pile driving, or the pouring of slabs or footings.<sup>[25]</sup>

## Commissioning and handover

[edit]

Main article: New-construction building commissioning

Commissioning is the process of verifying that all subsystems of a new building (or other assets) work as intended to achieve the owner's project requirements and as designed by the project's architects and engineers.

## Defects liability period

[edit]

A period after handover (or practical completion) during which the owner may identify any shortcomings in relation to the building specification ('defects'), with a view to the contractor correcting the defect.<sup>[26]</sup>

## Maintenance, repair and improvement

[edit]

Main article: Maintenance (technical)

Maintenance involves functional checks, servicing, repairing or replacing of necessary devices, equipment, machinery, building infrastructure, and supporting utilities in industrial, business, governmental, and residential installations.<sup>[27]</sup><sup>[28]</sup>

## Demolition

[edit]

Main article: Demolition

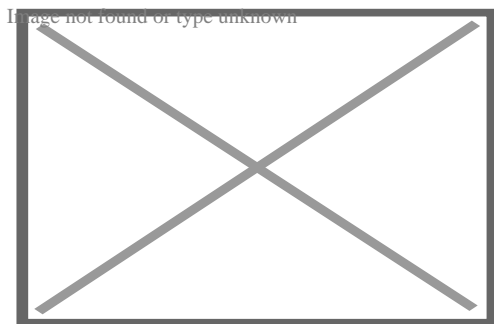
Demolition is the discipline of safely and efficiently tearing down buildings and other artificial structures. Demolition contrasts with deconstruction, which involves taking a building apart while carefully preserving valuable elements for reuse purposes (recycling – see also circular economy).

## Industry scale and characteristics

[edit]

## Economic activity

[edit]



Helicopter view of the Atacama Large Millimeter/submillimeter Array (ALMA) Operations Support Facility (OSF) construction site

The output of the global construction industry was worth an estimated \$10.8 trillion in 2017, and in 2018 was forecast to rise to \$12.9 trillion by 2022,<sup>[29]</sup> and to around \$14.8 trillion in 2030.<sup>[3]</sup> As a sector, construction accounts for more than 10% of global GDP (in developed countries, construction comprises 6–9% of GDP),<sup>[30]</sup> and employs around 7% of the total employed workforce around the globe<sup>[31]</sup> (accounting for over 273 million full- and part-time jobs in 2014).<sup>[32]</sup> Since 2010,<sup>[33]</sup> China has been the world's largest single construction market.<sup>[34]</sup> The United States is the second largest construction market with a 2018 output of \$1.581 trillion.<sup>[35]</sup>

- In the United States in February 2020, around \$1.4 trillion worth of construction work was in progress, according to the Census Bureau, of which just over \$1.0 trillion was for the private sector (split roughly 55:45% between residential and nonresidential); the remainder was public sector, predominantly for state and local government.<sup>[36]</sup>
- In Armenia, the construction sector experienced growth during the latter part of 2000s. Based on National Statistical Service, Armenia's construction sector

generated approximately 20% of Armenia's GDP during the first and second quarters of 2007. In 2009, according to the World Bank, 30% of Armenia's economy was from construction sector.<sup>[37]</sup>

- In Vietnam, the construction industry plays an important role in the national economy.<sup>[38][39][40]</sup> The Vietnamese construction industry has been one of the fastest growing in the Asia-Pacific region in recent years.<sup>[41][42]</sup> The market was valued at nearly \$60 billion in 2021.<sup>[43]</sup> In the first half of 2022, Vietnam's construction industry growth rate reached 5.59%.<sup>[43][44][45]</sup> In 2022, Vietnam's construction industry accounted for more than 6% of the country's GDP, equivalent to over 589.7 billion Vietnamese dong.<sup>[46][47]</sup> The industry of industry and construction accounts for 38.26% of Vietnam's GDP.<sup>[48][49][50]</sup> At the same time, the industry is one of the most attractive industries for foreign direct investment (FDI) in recent years.<sup>[51][52][53]</sup>

Construction is a major source of employment in most countries; high reliance on small businesses, and under-representation of women are common traits. For example:

- In the US, construction employed around 11.4m people in 2020, with a further 1.8m employed in architectural, engineering, and related professional services – equivalent to just over 8% of the total US workforce.<sup>[54]</sup> The construction workers were employed in over 843,000 organisations, of which 838,000 were privately held businesses.<sup>[55]</sup> In March 2016, 60.4% of construction workers were employed by businesses with fewer than 50 staff.<sup>[56]</sup> Women are substantially underrepresented (relative to their share of total employment), comprising 10.3% of the US construction workforce, and 25.9% of professional services workers, in 2019.<sup>[54]</sup>
- The United Kingdom construction sector contributed £117 billion (6%) to UK GDP in 2018, and in 2019 employed 2.4m workers (6.6% of all jobs). These worked either for 343,000 'registered' construction businesses, or for 'unregistered' businesses, typically self-employed contractors;<sup>[57]</sup> just over one million small/medium-sized businesses, mainly self-employed individuals, worked in the sector in 2019, comprising about 18% of all UK businesses.<sup>[58]</sup> Women comprised 12.5% of the UK construction workforce.<sup>[59]</sup>

According to McKinsey research, productivity growth per worker in construction has lagged behind many other industries across different countries including in the United States and in European countries. In the United States, construction productivity per worker has declined by half since the 1960s.<sup>[60]</sup>

## Construction GVA by country

[edit]


List of countries with the largest construction gross value added in 2018

**Economy**

**Construction GVA in 2018 (billions in USD)**

- (01)  **China** 934.2
- (02)  **United States** 839.1
- (03)  **Japan** 275.5
- (04)  **India** 201.2
- (05)  **Germany** 180.5
- (06)  **United Kingdom** 154.7
- (07)  **France** 138.7
- (08)  **Canada** 125.4
- (09)  **Russia** 121.2
- (10)  **Australia** 111.8
- (11)  **Indonesia** 109.7
- (12)  **South Korea** 93.0
- (13)  **Brazil** 92.6
- (14)  **Mexico** 89.0
- (15)  **Spain** 80.0
- (16)  **Italy** 78.9
- (17)  **Turkey** 55.3
- (18)  **Saudi Arabia** 40.2
- (19)  **Netherlands** 39.5

(20)  **Poland** 39.4

(21)  **Switzerland** 36.3

(22)  **United Arab Emirates** 34.5

(23)  **Sweden** 33.3

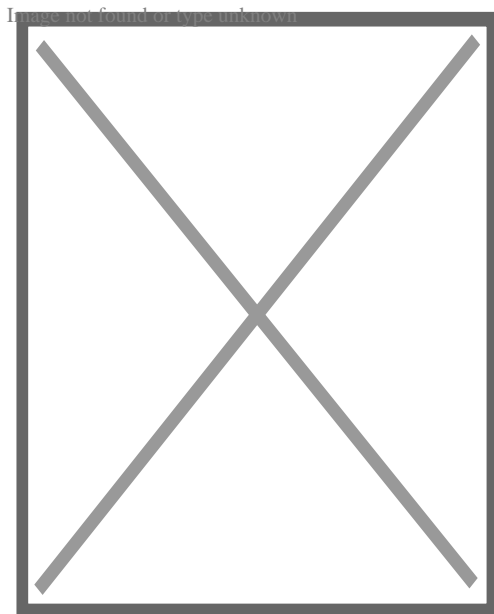
(24)  **Austria** 27.2

(25)  **Qatar** 27.0

The twenty-five largest countries in the world by construction GVA (2018)<sup>[61]</sup>

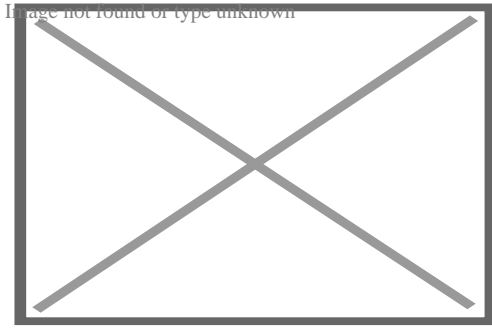
## Employment

[edit]



Ironworkers erecting the steel frame of a new building at Massachusetts General Hospital in Boston





A truck operator at Al Gamil, the largest construction company in Djibouti

Some workers may be engaged in manual labour<sup>[62]</sup> as unskilled or semi-skilled workers; they may be skilled tradespeople; or they may be supervisory or managerial personnel. Under safety legislation in the United Kingdom, for example, construction workers are defined as people "who work for or under the control of a contractor on a construction site";<sup>[63]</sup> in Canada, this can include people whose work includes ensuring conformance with building codes and regulations, and those who supervise other workers.<sup>[64]</sup>

Laborers comprise a large grouping in most national construction industries. In the United States, for example, in May 2023, the construction sector employed just over 7.9 million people, of whom 859,000 were laborers, while 3.7 million were construction trades workers (including 603,000 carpenters, 559,000 electricians, 385,000 plumbers, and 321,000 equipment operators).<sup>[65]</sup> Like most business sectors, there is also substantial white-collar employment in construction - out of 7.9 million US construction sector workers, 681,000 were recorded by the United States Department of Labor in May 2023 as in 'office and administrative support occupations', 620,000 in 'management occupations' and 480,000 in 'business and financial operations occupations'.<sup>[65]</sup>

Large-scale construction requires collaboration across multiple disciplines. A project manager normally manages the budget on the job, and a construction manager, design engineer, construction engineer or architect supervises it. Those involved with the design and execution must consider zoning requirements and legal issues, environmental impact of the project, scheduling, budgeting and bidding, construction site safety, availability and transportation of building materials, logistics, and inconvenience to the public, including those caused by construction delays.

Some models and policy-making organisations promote the engagement of local labour in construction projects as a means of tackling social exclusion and addressing skill shortages. In the UK, the Joseph Rowntree Foundation reported in 2000 on 25 projects which had aimed to offer training and employment opportunities for locally based school leavers and unemployed people.<sup>[66]</sup> The Foundation published "a good practice resource book" in this regard at the same time.<sup>[67]</sup> Use of local labour and local materials were specified for the construction of the Danish Storebaelt bridge, but there were legal issues which were challenged in court and addressed by the European Court

of Justice in 1993. The court held that a contract condition requiring use of local labour and local materials was incompatible with EU treaty principles.<sup>[68]</sup> Later UK guidance noted that social and employment clauses, where used, must be compatible with relevant EU regulation.<sup>[69]</sup> Employment of local labour was identified as one of several social issues which could potentially be incorporated in a sustainable procurement approach, although the interdepartmental *Sustainable Procurement Group* recognised that "there is far less scope to incorporate [such] social issues in public procurement than is the case with environmental issues".<sup>[70]</sup>

There are many routes to the different careers within the construction industry. There are three main tiers of construction workers based on educational background and training, which vary by country:

### **Unskilled and semi-skilled workers**

[edit]

Unskilled and semi-skilled workers provide general site labor, often have few or no construction qualifications, and may receive basic site training.

### **Skilled tradespeople**

[edit]

See also: List of construction trades

Skilled tradespeople have typically served apprenticeships (sometimes in labor unions) or received technical training; this group also includes on-site managers who possess extensive knowledge and experience in their craft or profession. Skilled manual occupations include carpenters, electricians, plumbers, ironworkers, heavy equipment operators and masons, as well as those involved in project management. In the UK these require further education qualifications, often in vocational subject areas, undertaken either directly after completing compulsory education or through "on the job" apprenticeships.<sup>[71]</sup>

### **Professional, technical or managerial personnel**

[edit]

Professional, technical and managerial personnel often have higher education qualifications, usually graduate degrees, and are trained to design and manage construction processes. These roles require more training as they demand greater

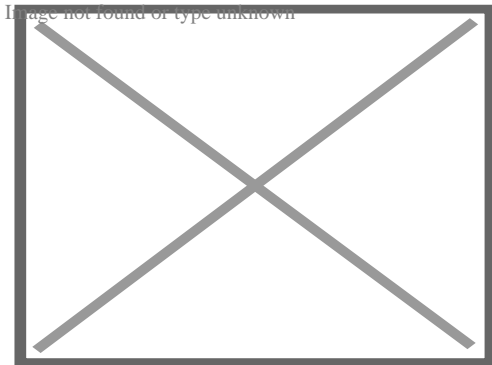
technical knowledge, and involve more legal responsibility. Example roles (and qualification routes) include:

- Architect – Will usually have studied architecture to degree level, and then undertaken further study and gained professional experience. In many countries, the title of "architect" is protected by law, strictly limiting its use to qualified people.
- Civil engineer – Typically holds a degree in a related subject and may only be eligible for membership of a professional institution (such as the UK's ICE) following completion of additional training and experience. In some jurisdictions, a new university graduate must hold a master's degree to become chartered,<sup>[a]</sup> and persons with bachelor's degrees may become Incorporated Engineers.
- Building services engineer – May also be referred to as an "M&E" or "mechanical, electrical, and plumbing (MEP) engineer" and typically holds a degree in mechanical or electrical engineering.<sup>[a]</sup>
- Project manager – Typically holds a 4-year or greater higher education qualification, but are often also qualified in another field such as architecture, civil engineering or quantity surveying.
- Structural engineer – Typically holds a bachelor's or master's degree in structural engineering.<sup>[a]</sup>
- Quantity surveyor – Typically holds a bachelor's degree in quantity surveying. UK chartered status is gained from the Royal Institution of Chartered Surveyors.

## Safety

[edit]

See also: Construction site safety



At-risk workers without appropriate safety equipment

Construction is one of the most dangerous occupations in the world, incurring more occupational fatalities than any other sector in both the United States and in the European Union.<sup>[4][72]</sup> In the US in 2019, 1,061, or about 20%, of worker fatalities in private industry occurred in construction.<sup>[4]</sup> In 2017, more than a third of US construction fatalities (366 out of 971 total fatalities) were the result of falls;<sup>[73]</sup> in the UK, half of the average 36 fatalities per annum over a five-year period to 2021 were

attributed to falls from height.<sup>[74]</sup> Proper safety equipment such as harnesses, hard hats and guardrails and procedures such as securing ladders and inspecting scaffolding can curtail the risk of occupational injuries in the construction industry.<sup>[75]</sup> Other major causes of fatalities in the construction industry include electrocution, transportation accidents, and trench cave-ins.<sup>[76]</sup>

Other safety risks for workers in construction include hearing loss due to high noise exposure, musculoskeletal injury, chemical exposure, and high levels of stress.<sup>[77]</sup> Besides that, the high turnover of workers in construction industry imposes a huge challenge of accomplishing the restructuring of work practices in individual workplaces or with individual workers.<sup>[citation needed]</sup> Construction has been identified by the National Institute for Occupational Safety and Health (NIOSH) as a priority industry sector in the National Occupational Research Agenda (NORA) to identify and provide intervention strategies regarding occupational health and safety issues.<sup>[78][79]</sup> A study conducted in 2022 found “significant effect of air pollution exposure on construction-related injuries and fatalities”, especially with the exposure of nitrogen dioxide.<sup>[80]</sup>

## Sustainability

[edit]

Main article: Sustainability in construction

Sustainability is an aspect of "green building", defined by the United States Environmental Protection Agency (EPA) as "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction."<sup>[81]</sup>

## Decarbonising construction

[edit]

The construction industry may require transformation at pace and at scale if it is to successfully contribute to achieving the target set out in The Paris Agreement of limiting global temperature rise to 1.5C above industrial levels.<sup>[82][83]</sup> The World Green Building Council has stated the buildings and infrastructure around the world can reach 40% less embodied carbon emissions but that this can only be achieved through urgent transformation.<sup>[84][85]</sup>

Conclusions from industry leaders have suggested that the net zero transformation is likely to be challenging for the construction industry, but it does present an opportunity. Action is demanded from governments, standards bodies, the construction sector, and the engineering profession to meet the decarbonising targets.<sup>[86]</sup>

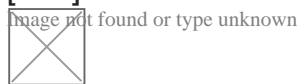
In 2021, the National Engineering Policy Centre published its report *Decarbonising Construction: Building a new net zero industry*,<sup>[86]</sup> which outlined key areas to decarbonise the construction sector and the wider built environment. This report set out around 20 different recommendations to transform and decarbonise the construction sector, including recommendations for engineers, the construction industry and decision makers, plus outlined six-overarching 'system levers' where action taken now will result in rapid decarbonisation of the construction sector.<sup>[86]</sup> These levels are:

- Setting and stipulating progressive targets for carbon reduction
- Embedding quantitative whole-life carbon assessment into public procurement
- Increasing design efficiency, materials reuse and retrofit of buildings
- Improving whole-life carbon performance
- Improving skills for net zero
- Adopting a joined up, systems approach to decarbonisation across the construction sector and with other sectors

Progress is being made internationally to decarbonise the sector including improvements to sustainable procurement practice such as the CO2 performance ladder in the Netherlands and the Danish Partnership for Green Public Procurement.<sup>[87][88]</sup> There are also now demonstrations of applying the principles of circular economy practices in practice such as Circl, ABN AMRO's sustainable pavilion and the Brighton Waste House.<sup>[89][90][91]</sup>

## See also

[edit]



Look up ***construction*** in Wiktionary, the free dictionary.

- Agile construction – Management system in the construction industry
- Building material – Material which is used for construction purposes
- Civil engineering – Engineering discipline focused on physical infrastructure
- Commissioning (construction) – Process to ensure that all building systems perform according to the "Design Intent"
- Environmental impact of concrete
- Impervious surface – Artificial structures such as pavements covered with water-tight materials
- Index of construction articles
- Land degradation – Gradual destruction of land

- List of tallest structures
- List of tallest structures built before the 20th century
- Modern methods of construction
- Outline of construction – Overview of and topical guide to construction
- Real estate development – Process that creates or renovates new or existing spaces
- Structural robustness – Ability of a structure to withstand physical strain
- Umarell – Bolognese slang term

 Architecture portal
  Engineering portal

## Notes

[edit]

1. <sup>^</sup> **a b c** In the UK, the Chartered Engineer qualification is controlled by the Engineering Council, and is often achieved through membership of the relevant professional institution (ICE, CIBSE, IStructE, etc).

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[edit]

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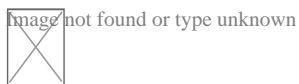
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### Construction

#### **Types**

- Home construction
- Offshore construction
- Underground construction
  - Tunnel construction

#### **History**

- Architecture
- Construction
- Structural engineering
- Timeline of architecture
- Water supply and sanitation
- Architect
- Building engineer
- Building estimator
- Building officials
- Chartered Building Surveyor

#### **Professions**

- Civil engineer
- Civil estimator
- Clerk of works
- Project manager
- Quantity surveyor
- Site manager
- Structural engineer
- Superintendent

**Trades  
workers  
(List)**

- Banksman
- Boilermaker
- Bricklayer
- Carpenter
- Concrete finisher
- Construction foreman
- Construction worker
- Electrician
- Glazier
- Ironworker
- Millwright
- Plasterer
- Plumber
- Roofer
- Steel fixer
- Welder
- American Institute of Constructors (AIC)
- American Society of Civil Engineers (ASCE)
- Asbestos Testing and Consultancy Association (ATAC)
- Associated General Contractors of America (AGC)
- Association of Plumbing and Heating Contractors (APHC)
- Build UK
- Construction History Society
- Chartered Institution of Civil Engineering Surveyors (CICES)
- Chartered Institute of Plumbing and Heating Engineering (CIPHE)
- Civil Engineering Contractors Association (CECA)
- The Concrete Society
- Construction Management Association of America (CMAA)
- Construction Specifications Institute (CSI)
- FIDIC
- Home Builders Federation (HBF)
- Lighting Association
- National Association of Home Builders (NAHB)
- National Association of Women in Construction (NAWIC)
- National Fire Protection Association (NFPA)
- National Kitchen & Bath Association (NKBA)
- National Railroad Construction and Maintenance Association (NRC)
- National Tile Contractors Association (NTCA)
- Railway Tie Association (RTA)
- Royal Institution of Chartered Surveyors (RICS)
- Scottish Building Federation (SBF)
- Society of Construction Arbitrators

**Organizations**

- By country**
  - India
  - Iran
  - Japan
  - Romania
  - Turkey
  - United Kingdom
  - United States
- Regulation**
  - Building code
  - Construction law
  - Site safety
  - Zoning
  - Style
    - List
- Architecture**
  - Industrial architecture
    - British
  - Indigenous architecture
  - Interior architecture
  - Landscape architecture
  - Vernacular architecture
  - Architectural engineering
  - Building services engineering
  - Civil engineering
    - Coastal engineering
    - Construction engineering
    - Structural engineering
- Engineering**
  - Earthquake engineering
  - Environmental engineering
  - Geotechnical engineering
  - List
- Methods**
  - Earthbag construction
  - Modern methods of construction
  - Monocrete construction
  - Slip forming

## Other topics

- Building material
  - List of building materials
  - Millwork
- Construction bidding
- Construction delay
- Construction equipment theft
- Construction loan
- Construction management
- Construction waste
- Demolition
- Design–build
- Design–bid–build
- DfMA
- Heavy equipment
- Interior design
- Lists of buildings and structures
- Megaproject
- Megastructure
- Plasterwork
  - Damp
    - Proofing
  - Parge coat
  - Roughcast
    - Harling
- Real estate development
- Stonemasonry
- Sustainability in construction
- Unfinished building
- Urban design
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Construction industry by country

- Canada
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- Hong Kong SAR
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- v
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Tallest buildings and structures

- By category

**By region**

- Africa
- Asia
  - Indian subcontinent
  - Southeast
- Europe
  - Balkans
  - Baltic states
  - Scandinavia
- Oceania
- Southern Hemisphere
- The Americas
  - North America
  - Central America
  - Latin America
  - South America
- Afghanistan
- Albania
- Algeria
- Argentina
- Australia
- Austria
- Azerbaijan
- Bangladesh
- Bolivia
- Bosnia and Herzegovina
- Brazil
- Bulgaria
- Cambodia
- Canada
- Chile
- China (Hong Kong, Macau)
- Colombia
- Croatia
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- Egypt
- Estonia
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- France
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- Indonesia
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- Asia
  - Indian subcontinent
  - West Asia
- Europe
  - former Soviet Union
- The Americas
  - South America

- Afghanistan
- Albania
- Algeria
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- Luxembourg
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**Structures  
of any type  
(History)**

## Related topics

- Air traffic obstacle
- Antenna height considerations
- Architectural engineering
- Construction
- Fires
- Groundscraper
- Guyed mast
- Height restriction laws
- Skyscraper
  - Early skyscrapers
  - Skyscraper Index
- Storey
- Tower block
- Vanity height

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## About Environmental accounting

**Environmental accounting** is a subset of accounting proper, its target being to incorporate both economic and environmental information. It can be conducted at the corporate level or at the level of a national economy through the System of Integrated Environmental and Economic Accounting, a satellite system to the National Accounts of Countries<sup>[1]</sup> (among other things, the National Accounts produce the estimates of gross domestic product otherwise known as GDP).

Environmental accounting is a field that identifies resource use, measures and communicates costs of a company's or national economic impact on the environment. Costs include costs to clean up or remediate contaminated sites, environmental fines, penalties and taxes, purchase of pollution prevention technologies and waste management costs.

An environmental accounting system consists of environmentally differentiated conventional accounting and ecological accounting. Environmentally differentiated accounting measures effects of the natural environment on a company in monetary terms. Ecological accounting measures the influence a company has on the environment, but in physical measurements.

## Reasons for use

[edit]

There are several advantages environmental accounting brings to business; notably, the complete costs, including environmental remediation and long term environmental consequences and externalities can be quantified and addressed.

More information about the statistical system of environmental accounts are available here: [System of Integrated Environmental and Economic Accounting](#).

## Subfields

[edit]

Environmental accounting is organized in three sub-disciplines: global, national, and corporate environmental accounting, respectively. Corporate environmental accounting can be further sub-divided into environmental management accounting and environmental financial accounting.

- **Global environmental accounting** is an accounting methodology that deals areas includes energetics, ecology and economics at a worldwide level.
- **National environmental accounting** is an accounting approach that deals with economics on a country's level.

Internationally, environmental accounting has been formalised into the System of Integrated Environmental and Economic Accounting, known as SEEA.<sup>[2]</sup> SEEA grows out of the System of National Accounts. The SEEA records the flows of raw materials (water, energy, minerals, wood, etc.) from the environment to the economy, the exchanges of these materials within the economy and the returns of wastes and pollutants to the environment. Also recorded are the prices or shadow prices for these materials as are environment protection expenditures. SEEA is used by 49 countries around the world.<sup>[3]</sup>

- **Corporate environmental accounting** focuses on the cost structure and environmental performance of a company.<sup>[4]</sup>
- **Environmental management accounting** focuses on making internal business strategy decisions. It can be defined as:

*"..the identification, collection, analysis, and use of two types of information for internal decision making:*

1) Physical information on the use, flows and fates of energy, water and materials (including wastes) and

2) Monetary information on environmentally related costs, earnings and savings."<sup>[5]</sup>

As part of an environmental management accounting project in the State of Victoria, Australia, four case studies were undertaken in 2002 involving a school

(Methodist Ladies College, Perth), plastics manufacturing company (Cormack Manufacturing Pty Ltd, Sydney), provider of office services (a service division of AMP, Australia wide) and wool processing (GH Michell & Sons Pty Ltd, Adelaide). Four major accounting professionals and firms were involved in the project; KPMG (Melbourne), Price Waterhouse Coopers (Sydney), Professor Craig Deegan, RMIT University (Melbourne) and BDO Consultants Pty Ltd (Perth). In February 2003, John Thwaites, The Victorian Minister for the Environment launched the report which summarised the results of the studies.<sup>[1]</sup>

These studies were supported by the Department of Environment and Heritage of the Australian Federal Government, and appear to have applied some of the principles outlined in the United Nations Division for Sustainable Development publication, *Environmental Management Accounting Procedures and Principles* (2001).

- **Environmental financial accounting** is used to provide information needed by external stakeholders on a company's financial performance. This type of accounting allows companies to prepare financial reports for investors, lenders and other interested parties.<sup>[6]</sup>
- **Certified emission reductions (CERs) accounting** comprises the recognition, the non-monetary and monetary evaluation and the monitoring of Certified emission reductions (CERs) and GHGs (greenhouse gases) emissions on all levels of the value chain and the recognition, evaluation and monitoring of the effects of these emissions credits on the carbon cycle of ecosystems.<sup>[2]</sup>

[3]

## Companies specialised in Environmental Accounting

[edit]

- NEMS AS

## Examples of software

[edit]

- EHS Data's Environmental and Sustainability Accounting and Management System
- Emisoft's Total Environmental Accounting and Management System (TEAMS)
- NEMS's NEMS Accounter




## Examples of software as a service

[edit]

- Greenbase Online Environmental Accountancy

## See also

[edit]

-  Business and economics portal
-  Ecology portal
-  Environment portal
- Anthropogenic metabolism
- Carbon accounting
- Defensive expenditures
- Ecological economics
- Ecosystem services
- Emergy synthesis
- Environmental data
- Environmental economics
- Environmental enterprise
- Environmental finance
- Environmental monitoring
- Environmental management system
- Environmental pricing reform
- Environmental profit and loss account
- Fiscal environmentalism
- Full cost accounting (FCA)
- Greenhouse gas emissions accounting
- Industrial metabolism
- Material flow accounting
- Material flow analysis
- Monitoring Certification Scheme
- Social metabolism
- Sustainability accounting
- System of Integrated Environmental and Economic Accounting
- Urban metabolism

## References

[edit]

## Notes

[edit]

1. <sup>^</sup> *"Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003" (PDF)*. United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development and World Bank. Archived from the original (PDF) on 2011-06-01. Retrieved 2013-05-02.

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6. ^ "Global Assessment of Environment Statistics and Environmental-Economic Accounting 2007" (PDF). United Nations.

## Footnotes

[edit]

1. ^ Environmental Management Accounting: An Introduction and Case Studies (Adobe PDF file, 446KB)
2. ^ Kumar, P. and Firoz, M. (2019), "Accounting for certified emission reductions (CERs) in India: An analysis of the disclosure and reporting practices within the financial statements", Meditari Accountancy Research. <https://doi.org/10.1108/MEDAR-01-2019-0428>
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## Further reading

[edit]

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- o Tennenbaum, S.E. (1988) *Network Energy Expenditures for Subsystem Production*, MS Thesis. Gainesville, FL: University of FL, 131 pp. (CFW-88-08)

### External links

[edit]

- o United Nations Environmental Accounting
- o Green Accounting for Indian States Project

- Environmental MBA Degree Info
- Environmental Accounting in Austria (Information about environmental accounts, structure, methods, legal basis, scope and application)
- Environmental Management Accounting (EMA) Project Archived 2012-04-30 at the Wayback Machine, Victoria, Australia
- v
- t
- e

## Sustainability

- Outline
- Index

### Principles

- Anthropocene
- Environmentalism
- Global governance
- Human impact on the environment
- Planetary boundaries
- Development
- Anthropization
- Anti-consumerism
- Circular economy
- Durable good
- Earth Overshoot Day
- Ecological footprint
- Ethical
- Green consumption
- Micro-sustainability
- Over-consumption
- Product stewardship

### Consumption

- Simple living
- Social return on investment
- Steady-state economy
- Sustainability
  - Advertising
  - Brand
  - Marketing myopia
- Sustainable
  - Consumer behaviour
  - Market
- Systemic change resistance
- Tragedy of the commons

- World population**
  - Control
  - Demographic transition
  - Dependency ratio
    - List
  - Family planning
  - Intergenerational equity
  - Population ageing
  - Sustainable population
  - Appropriate
  - Environmental technology
- Technology**
  - Natural building
  - Sustainable architecture
  - Sustainable design
  - Sustainable industries
  - Sustainable packaging
  - Biosecurity
  - Biosphere
- Biodiversity**
  - Conservation biology
  - Endangered species
  - Holocene extinction
  - Invasive species
- Energy**
  - Carbon footprint
  - Renewable energy
  - Sustainable energy
  - Civic agriculture
  - Climate-smart agriculture
- Food**
  - Community-supported agriculture
  - Cultured meat
  - Sustainable agriculture
  - Sustainable diet
  - Sustainable fishery



## **Water**

- Air well (condenser)
- Bioretention
- Bioswale
- Blue roof
- Catchwater
- Constructed wetland
- Detention basin
- Dew pond
- Footprint
- Hydroelectricity
- Hydropower
- Infiltration basin
- Irrigation tank
- Marine energy
- Micro hydro
- Ocean thermal energy conversion
- Pico hydro
- Rain garden
- Rainwater harvesting
- Rainwater tank
- Reclaimed water
- Retention basin
- Run-of-the-river hydroelectricity
- Scarcity
- Security
- Small hydro
- Sustainable drainage system
- Tidal power
- Tidal stream generator
- Tree box filter
- Water conservation
- Water heat recycling
- Water recycling shower
- Water-sensitive urban design

## **Accountability**

- Corporate environmental responsibility
- Corporate social responsibility
- Environmental accounting
- Environmental full-cost accounting
- Environmental planning
- Sustainability
  - Accounting
  - Measurement
  - Metrics and indices
  - Reporting
  - Standards and certification
- Sustainable yield



## **Applications**

- Advertising
- Art
- Business
- City
- Climate finance
- Community
- Disinvestment
- Eco-capitalism
- Eco-cities
- Eco-investing
- Eco-socialism
- Ecovillage
- Environmental finance
- Green economy
  - Construction
  - Fashion
  - Finance
- Gardening
- Geopark
- Green
  - Development
  - Infrastructure
  - Marketing
- Green roof
- Greening
- Impact investing
- Landscape
- Livelihood
- Living
- Market
- Organic movement
- Organizations
- Procurement
- Refurbishment
- Socially responsible business
- Socially responsible marketing
- Sanitation
- Sourcing
- Space
- Sustainability organization
- Tourism
- Transport
- Urban drainage systems
- Urban infrastructure

## **Sustainable management**

- Environmental
- Fisheries
- Forest
- Humanistic capitalism
- Landscape
- Materials
- Natural resource
- Planetary
- Recycling
- Waste
- UN Conference on the Human Environment (Stockholm 1972)
- Brundtlandt Commission Report (1983)
- *Our Common Future* (1987)
- Earth Summit (1992)
- Rio Declaration on Environment and Development (1992)
- Agenda 21 (1992)
- Convention on Biological Diversity (1992)
- Lisbon Principles (1997)
- Earth Charter (2000)
- UN Millennium Declaration (2000)
- Earth Summit 2002 (Rio+10, Johannesburg)
- UN Conference on Sustainable Development (Rio+20, 2012)
- Sustainable Development Goals (2015)

## **Agreements and conferences**

-  **Category** image not found or type unknown
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- **Studies**
- **Degrees**

- v
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Social and environmental accountability

## **Ethics and principles**

- Aarhus Convention
- Climate justice
- Corporate accountability / behaviour / environmental responsibility / responsibility / social responsibility
- Dirty hands
- Environmental racism / in Russia / in the United States / in Western Europe / inequality in the UK / injustice in Europe
- Ethical banking
- Ethical code
- Extended producer responsibility
- Externality
- Harm
- Little Eichmanns
- Loss and damage
- Organizational ethics
- Organizational justice
- Pollution
- Principles for Responsible Investment
- Racism
- Social impact assessment
- Social justice
- Social responsibility
- Stakeholder theory
- Sullivan principles
- Transparency (behavioral social)
- UN Global Compact
- Corporate crime
- Double bottom line
- Ethical positioning index
- Higg Index
- Impact assessment (environmental equality social)
- ISO 26000
- ISO 45001
- Genuine progress indicator
- Performance indicator
- SA 8000
- OHSAS 18001
- Social return on investment
- Whole-life cost

## **Social accounting**

Clean up after the Exxon

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- Carbon accounting
- Eco-Management and Audit Scheme
- Emission inventory
- Environmental full-cost accounting / Environmental conflict / impact assessment / management system / profit-and-loss account
- Environmental accounting**
  - ISO 14000
  - ISO 14031
  - Life-cycle assessment
  - Pollutant release and transfer register
  - Sustainability accounting / measurement / metrics and indices / standards and certification / supply chain
  - Toxics Release Inventory
  - Triple bottom line
- Reporting**
  - Global Reporting Initiative
  - GxP guidelines
  - Sustainability reporting
  - Community-based monitoring
- Auditing**
  - Environmental (certification)
  - Fair trade (certification)
  - ISO 19011

- Bangladesh Accord
- Benefit corporation
- Child labour
- Community interest company
- Conflict of interest
- Disasters
- Disinvestment
- Eco-labeling
- Environmental degradation
- Environmental pricing reform
- Environmental, social, and corporate governance
- Ethical consumerism
- Euthenics
- Global justice movement
- Health impact assessment
- Market governance mechanism
- Product certification
- Public participation
- SDG Publishers Compact
- Social enterprise
- Socially responsible business
- Socially responsible investing
- Socially responsible marketing
- Stakeholder (engagement)
- Supply chain management

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## Frequently Asked Questions

What are the key factors that can compromise the sound isolation performance of a building assembly, regardless of the materials used, and how can these be avoided during construction?

Flanking paths (sound traveling around the assembly), gaps or penetrations in the assembly (outlets, pipes, ducts), and poor workmanship (e.g. bridging resilient channels, incorrect underlayment installation) are key compromise factors. Avoid these by

Field Testing Airborne and Impact Sound Levels

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