The Birth of DIN 4171: Design, Forced Labor, and the Standardization of "Widerspruchsfreiheit" in Nazi Germany

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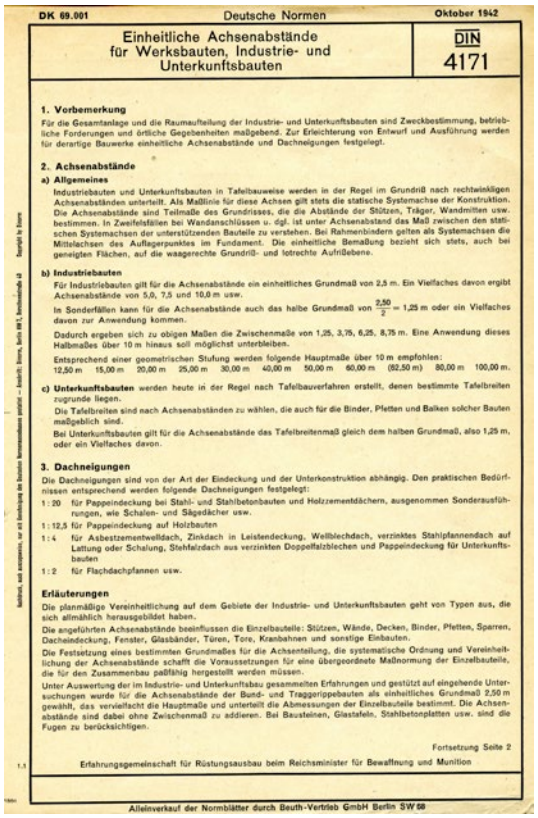
Most architectural theorists tend to assume that design lays the foundation for construction. The writings of Robin Evans, for example, suggest as much.[2] One cannot forget, however, that design is also "designed". It is a system of communication, one with a grammar of its own. Units of measurement (for example, the metric system) belong to this grammar, and technical standards do as well. Technical standards (or "standard sheets" as they are often called) are typically issued by accredited standards organizations – for example DIN ("Deutsches Institut für Normung"), ASTM ("American Society for Testing and Materials"), NIST ("National Institute of Standards and Technology"), AFNOR ("Association Française de Normalisation"), or ISO ("International Organization for Standardization"). Furthermore, a principle known as "Widerspruchsfreiheit" - which is sometimes translated as "harmonization" but is best rendered as "freedom from contradiction" - is considered sacrosanct to many such organizations. This means that the information contained in one standard needs to be consistent with that which is found in another. If it is not – if, for example, a DIN standard describing envelope sizes contradicts the content of one describing standard paper sizes – one of the two will need to be withdrawn or amended. This is to ensure consistency and efficiency. To quote from DIN's website, "DIN's employees organize standards work on a German, European, and international level. They ensure cohesion and Widerspruchsfreiheit."[3]

In Germany, two specific standard sheets, DIN 4171 and DIN 4172, helped bring the principle of "Widerspruchsfreiheit" into the construction industry (Figs. 1, 2). They help normalize systems-based thinking in the design profession, at least in Germany. They are the foundation for West Germany's postwar reconstruction and have influenced prefabrication practices for the better part of the last sixty years. Both were developed by DIN's Construction Standards Committee ("Fachnormenausschuß Bauwesen"), which was established toward the end of 1917, soon after the foundation of DIN itself. DIN 4171 was issued in October 1942 and DIN 4172 in January 1951. Both offer instructions on how one can use grid systems to simplify the design process, as well as to foster continuity and consistency between designers, builders, engineers, and fabricators. DIN 4171 states that the size of each module within a gridded system should measure 1.25 or 2.5 m, depending on the building type in question: "For industrial buildings, axial distances maintain a standard measurement of 2.5 m (...) Under special circumstances, half of the standard measurement (2.5 m/2 = 1.25 m or a multiple thereof) can also be used."[4] DIN 4172 is intended mainly for masonry structures and was based originally on a



DK 69.001 Deutsche Normen Oktober 1942

Einheitliche Achsenabstände für Werksbauten, Industrie- und Unterkunftsbauten

DIN 4171

1. Vorbemerkung

Für die Gesamtanlage und die Raumaufteilung der Industrie- und Unterkunftsbauten sind Zweckbestimmung, betriebliche Forderungen und örtliche Gegebenheiten maßgebend. Zur Erleichterung von Entwurf und Ausführung werden für derartige Bauwerke einheitliche Achsenabstände und Dachneigungen festgelegt.

2. Achsenabstände

a) Allgemeines

Industriebauten und Unterkunftsbauten in Tafelbauweise werden in der Regel im Grundriß nach rechtwinkligen Achsenabständen unterteilt. Als Maßlinie für diese Achsen gilt stets die statische Systemachse der Konstruktion. Die Achsenabstände sind Teilmaße des Grundrisses, die die Abstände der Stützen, Träger, Wandmitten usw. bestimmen. In Zweifelsfällen bei Wandanschlüssen u. dgl. ist unter Achsenabstand das Maß zwischen den statischen Systemachsen der unterstützenden Bauteile zu verstehen. Bei Rahmenbindern gelten als Systemachsen die Mittelachsen des Auflagerpunktes im Fundament. Die einheitliche Bemaßung bezieht sich stets, auch bei geneigten Flächen, auf die waagerechte Grundriß- und lotrechte Aufrißebene.

b) Industriebauten

Für Industriebauten gilt für die Achsenabstände ein einheitliches Grundmaß von 2,5 m. Ein Vielfaches davon ergibt Achsenabstände von 5,0, 7,5 und 10,0 m usw.

In Sonderfällen kann für die Achsenabstände auch das halbe Grundmaß von $\frac{2{,}50}{2} = 1{,}25$ m oder ein Vielfaches davon zur Anwendung kommen.

Dadurch ergeben sich zu obigen Maßen die Zwischenmaße von 1,25, 3,75, 6,25, 8,75 m. Eine Anwendung dieses Halbmaßes über 10 m hinaus soll möglichst unterbleiben.

Entsprechend einer geometrischen Stufung werden folgende Hauptmaße über 10 m empfohlen:
12,50 m 15,00 m 20,00 m 25,00 m 30,00 m 40,00 m 50,00 m 60,00 m (62,50 m) 80,00 m 100,00 m.

c) Unterkunftsbauten werden heute in der Regel nach Tafelbauverfahren erstellt, denen bestimmte Tafelbreiten zugrunde liegen.

Die Tafelbreiten sind nach Achsenabständen zu wählen, die auch für die Binder, Pfetten und Balken solcher Bauten maßgeblich sind.

Bei Unterkunftsbauten gilt für die Achsenabstände das Tafelbreitenmaß gleich dem halben Grundmaß, also 1,25 m, oder ein Vielfaches davon.

3. Dachneigungen

Die Dachneigungen sind von der Art der Eindeckung und der Unterkonstruktion abhängig. Den praktischen Bedürfnissen entsprechend werden folgende Dachneigungen festgelegt:

1 : 20 für Pappeindeckung bei Stahl- und Stahlbetonbauten und Holzzementdächern, ausgenommen Sonderausführungen, wie Schalen- und Sägedächer usw.

1 : 12,5 für Pappeindeckung auf Holzbauten

1 : 4 für Asbestzementwelldach, Zinkdach in Leistendeckung, Wellblechdach, verzinktes Stahlpfannendach auf Lattung oder Schalung, Stehfalzdach aus verzinkten Doppelfalzblechen und Pappeindeckung für Unterkunftsbauten

1 : 2 für Flachdachpfannen usw.

Erläuterungen

Die planmäßige Vereinheitlichung auf dem Gebiete der Industrie- und Unterkunftsbauten geht von Typen aus, die sich allmählich herausgebildet haben.

Die angeführten Achsenabstände beeinflussen die Einzelbauteile: Stützen, Wände, Decken, Binder, Pfetten, Sparren, Dacheindeckung, Fenster, Glasbänder, Türen, Tore, Kranbahnen und sonstige Einbauten.

Die Festsetzung eines bestimmten Grundmaßes für die Achsenteilung, die systematische Ordnung und Vereinheitlichung der Achsenabstände schafft die Voraussetzungen für eine übergeordnete Maßnormung der Einzelbauteile, die für den Zusammenbau paßfähig hergestellt werden müssen.

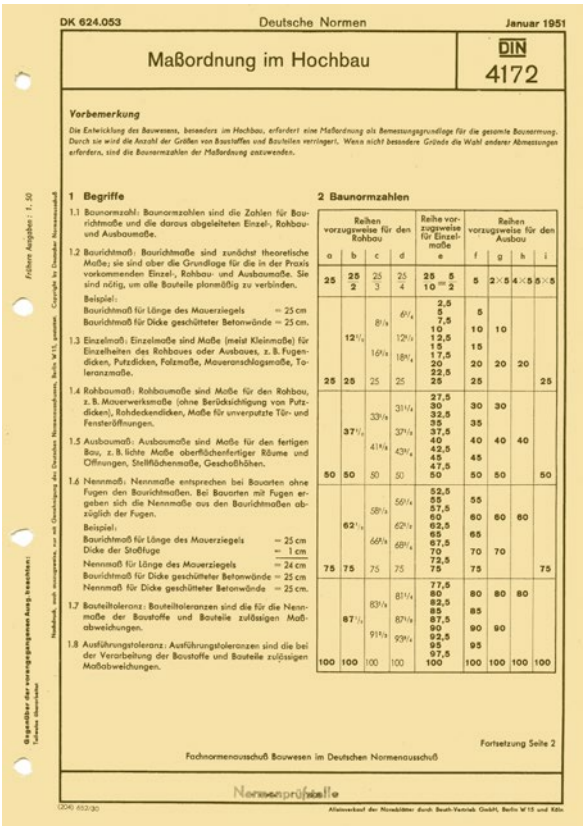
Unter Auswertung der im Industrie- und Unterkunftsbau gesammelten Erfahrungen und gestützt auf eingehende Untersuchungen wurde für die Achsenabstände der Bund- und Traggerippebauten als einheitliches Grundmaß 2,50 m gewählt, das vervielfacht die Hauptmaße und unterteilt die Abmessungen der Einzelbauteile bestimmt. Die Achsenabstände sind dabei ohne Zwischenmaß zu addieren. Bei Bausteinen, Glastafeln, Stahlbetonplatten usw. sind die Fugen zu berücksichtigen.

Fortsetzung Seite 2

Erfahrungsgemeinschaft für Rüstungsausbau beim Reichsminister für Bewaffnung und Munition

Alleinverkauf der Normblätter durch Beuth-Vertrieb GmbH Berlin SW 68

1 „Einheitliche Achsenabstände für Werksbauten, Industrie- und Unterkunftsbauten“ (DIN 4171) can be rendered in English as „Unified Axial Distances for Factories, Industrial Buildings, and Temporary Structures.“ With DIN 4172, it laid the groundwork for the normalization of „Widerspruchsfreiheit“ in the construction industry. It was probably developed with timber, steel, and concrete structures in mind.



DK 624.053 Deutsche Normen Januar 1951

Maßordnung im Hochbau

DIN 4172

Vorbemerkung

Die Entwicklung des Bauwesens, besonders im Hochbau, erfordert eine Maßordnung als Bemessungsgrundlage für die gesamte Baunormung. Durch sie wird die Anzahl der Größen von Baustoffen und Bauteilen verringert. Wenn nicht besondere Gründe die Wahl anderer Abmessungen erfordern, sind die Baunormzahlen der Maßordnung anzuwenden.

1 Begriffe

1.1 Baunormzahl: Baunormzahlen sind die Zahlen für Baurichtmaße und die daraus abgeleiteten Einzel-, Rohbau- und Ausbaumaße.

1.2 Baurichtmaß: Baurichtmaße sind zunächst theoretische Maße; sie sind aber die Grundlage für die in der Praxis vorkommenden Einzel-, Rohbau- und Ausbaumaße. Sie sind nötig, um alle Bauteile planmäßig zu verbinden.

Beispiel:
Baurichtmaß für Länge des Mauerziegels = 25 cm
Baurichtmaß für Dicke geschütteter Betonwände = 25 cm.

1.3 Einzelmaß: Einzelmaße sind Maße (meist Kleinmaße) für Einzelheiten des Rohbaues oder Ausbaues, z. B. Fugendicken, Putzdicken, Falzmaße, Maueranschlagsmaße, Toleranzmaße.

1.4 Rohbaumaß: Rohbaumaße sind Maße für den Rohbau, z. B. Mauerwerksmaße (ohne Berücksichtigung von Putzdicken), Rohdeckendicken, Maße für unverputzte Tür- und Fensteröffnungen.

1.5 Ausbaumaß: Ausbaumaße sind Maße für den fertigen Bau, z. B. lichte Maße oberflächenfertiger Räume und Öffnungen, Stellflächenmaße, Geschoßhöhen.

1.6 Nennmaß: Nennmaße entsprechen bei Bauarten ohne Fugen den Baurichtmaßen. Bei Bauarten mit Fugen ergeben sich die Nennmaße aus den Baurichtmaßen abzüglich der Fugen.

Beispiel:
Baurichtmaß für Länge des Mauerziegels = 25 cm
Dicke der Stoßfuge = 1 cm
Nennmaß für Länge des Mauerziegels = 24 cm
Baurichtmaß für Dicke geschütteter Betonwände = 25 cm
Nennmaß für Dicke geschütteter Betonwände = 25 cm.

1.7 Bauteiltoleranz: Bauteiltoleranzen sind die für die Nennmaße der Baustoffe und Bauteile zulässigen Maßabweichungen.

1.8 Ausführungstoleranz: Ausführungstoleranzen sind die bei der Verarbeitung der Baustoffe und Bauteile zulässigen Maßabweichungen.

2 Baunormzahlen

Reihen vorzugsweise für den Rohbau				Reihe vorzugsweise für Einzelmaße	Reihen vorzugsweise für den Ausbau			
a	b	c	d	e	f	g	h	i
25	25/2	25/3	25/4	25 – 5 – 10 – 2	5	2×5	4×5	5×5
			6¼	2,5				
				5				
		8⅓		7,5				
	12½		12½	10	10	10		
				12,5				
		16⅔	18¾	15	15			
				17,5				
				20	20	20	20	
25	25	25	25	22,5				
				25	25			25
			31¼	27,5				
		33⅓		30	30	30		
	37½		37½	32,5				
				35	35			
		41⅔	43¾	37,5				
				40	40	40	40	
				42,5	45			
				45				
				47,5				
50	50	50	50	50	50	50		50
			56¼	52,5				
		58⅓		55	55			
				57,5				
	62½		62½	60	60	60	60	
				62,5				
		66⅔	68¾	65	65			
				67,5				
				70	70	70		
				72,5				
75	75	75	75	75	75	75		75
				77,5				
			81¼	80	80	80	80	
		83⅓		82,5				
	87½		87½	85	85			
				87,5				
		91⅔	93¾	90	90	90		
				92,5				
				95	95			
				97,5				
100	100	100	100	100	100	100	100	100

Fortsetzung Seite 2

Fachnormenausschuß Bauwesen im Deutschen Normenausschuß

Normenprüfstelle

(204) 652/30 Alleinverkauf der Normblätter durch Beuth-Vertrieb GmbH, Berlin W 15 und Köln

2 „Maßordnung im Hochbau“ (DIN 4172) translates into English as „Dimensional Coordination in Construction.“ It was principally conceived with the standardization of masonry dwellings in mind.

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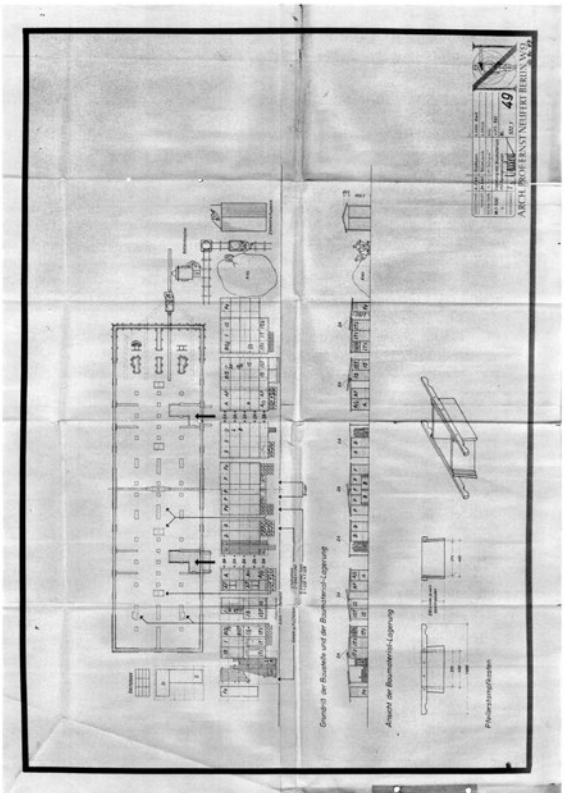
12.5-centimeter system of dimensional coordination: “Standard dimensions: standard dimensions are at first theoretical measurements; they are, however, the foundation for the measurements of the structure and interior design. They are necessary for the purpose of uniting all building components in a systematic way. To name an example: standard dimension for the length of a masonry unit = 25 cm. Standard dimension for the thickness of poured-in-place concrete walls = 25 cm.”[5]

At the time that standards experts began pursuing “Widerspruchsfreiheit”, construction specifications were still being developed on an ad hoc basis. This is partly because architects in the 1930s were still strongly wedded to the classical notion of design as “Baukunst”, as a “building art.” Prefabrication was still in its infancy, at least in Germany, and resistance from manufacturers, skilled tradesmen, and builders was high. DIN’s Construction Committee housed numerous subcommittees and working groups, many of which worked in isolation of one another; its members appear to have been largely unaware of what other technical committees were doing. This tended to generate confusion and misunderstanding within DIN as a whole. As one early member of DIN’s Construction Committee put it, “[m]any professionals [in architecture] were themselves unclear about the goals of standardization. As a rule, the objective was typically as follows: only one door lock, only one series of screws, finally also only one house, at least as a pattern for each user group. These were caricatures which left many of the participants feeling timid.”[6]



3 Ernst Neufert, „Temporary Shelter for Those Displaced by Bombings." Neufert developed this project at the request of Hitler's Housing Commissar Robert Ley. The project documents how DIN 4171 could be used as a construction management tool.

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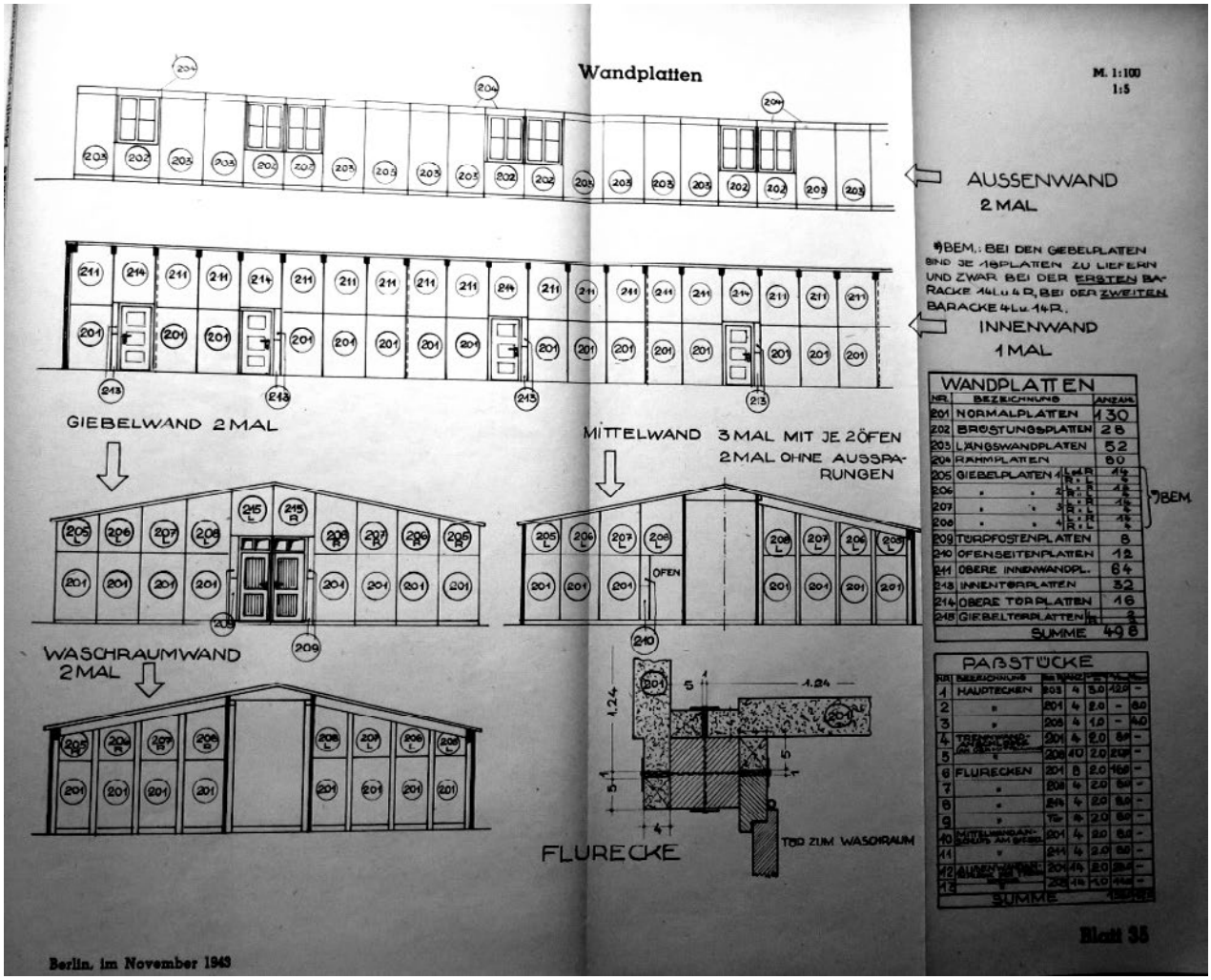
How, then, did DIN 4171 and 4172 first gain currency? How and why did "Widerspruchsfreiheit" gain widespread recognition? These are important questions to answer because they can also help us historicize the design of design as we understand it today. In general, two factors proved especially important: one was Hitler's Four-Year Plan, which was announced in 1936. Hitler introduced it to facilitate Germany's preparedness for war, to foster Nazi Germany's economic self-sufficiency, and to consolidate his control over the economy as a whole. The Four-Year Plan centralized the management of the construction industry and militarized the private sector. It stimulated the rapid growth of the country's airplane industry, it normalized the Nazis' authoritarian brand of corporate capitalism, and it heralded the widespread use of standards in the manufacturing sector. This is because it gave government the power to declare select standards and logistical practices legally binding. "The priorities were being set by the regime, not by industry, and mechanisms were being put in place to make sure that business fulfilled them whatever the consequences to itself", as Richard Evans has noted.[7]

A second and perhaps more relevant force was Albert Speer. His importance to the history of standardization in Germany cannot be overstated. It is precisely his contributions to the history of "Widerspruchsfreiheit" that I want to devote my attention to here. Hitler appointed him his General Building Inspector for the Imperial Capital ("Generalbauinspektor für die Reichshauptstadt" or "GBI") in 1937. Between 1937 and the end of 1941, he had two principle responsibilities: he was tasked with transforming Berlin into a temple to National Socialist power and a pilgrimage site for admirers: "On the northern side, near the Reichstag, [Hitler] wanted a huge meeting hall, a domed structure into which St. Peter's Cathedral in Rome would have fitted several times over."[8] He was also entrusted with the design of countless hundreds of airplane factories and storage facilities. Speer did so at the behest of Hermann Göring, who oversaw the execution of the Four-Year Plan. As Susan Willems notes, "From the second year of the war onward, a number of war-related projects made up a large part of the activities of the GBI: armaments building, air raid shelters, aerial bombing removal, and the implementation of building brigades for the Organisation Todt. In November 1939 Speer led the armaments efforts of the 'Luftwaffe', in July 1941 that of the industrial building efforts of the 'Göring Program' as well. Individual contracts from the army and the navy followed thereafter. By the beginning of the third year of the war, Speer's building brigades from the GBI were involved in the building of 1,352 structures for the Luftwaffe and the U-boat program and 83 factory-related projects."[9]

In carrying out his responsibilities, Speer leaned heavily on a close-knit group of loyalists. His office had three departments – a Planning Division ("Planungstelle"), an Administrative Division ("Verwaltungsstelle"), and a General Construction Office



4 This Massive Barrack Unit illustrated how DIN 4171 could be used to facilitate the fabrication of standardized concrete structures.

("Generalbauleitung"). The General Construction Office's mandate included "the procurement of necessary materials (stones, brick, etc.) [and t]he allocation of construction workers on individual construction sites."[10] An architect from Nuremberg by the name of Walter Brugmann headed this division, and the "Neues Bauen" architect and builder Ernst Neufert played a crucial role as well. With Speer, Neufert was the most influential proponent of standardization in Nazi Germany. He was an expert in rapid building systems, concrete construction, and construction management; he was one of the most vocal advocates of "Widerspruchsfreiheit" at the time.[11] He was among the first students to study at the Bauhaus in Weimar. Between 1922 and 1926, he was an architect and construction manager in the office of Walter Gropius as well. From 1926 to 1930, he was a professor at the State Construction College of Weimar ("Staatliche Bauhochschule Weimar"), whose faculty included a number of Bauhaus graduates and prominent CIAM members. He was the author of the "Bauentwurfslehre", which is still the most influential standards handbook in the world today. The book has passed through forty German-language editions since its initial publication in 1936, and authorized translations are available in nearly twenty languages. The general goal of the first edition of the "Bauentwurfslehre" was to dispense knowledge about the "[p]rinciples, standards, and guidelines for site planning, construction, design, and spatial requirements, spatial relationships, and measurements for buildings, spaces, furnishings and objects, with man as both the measure and the end."[12] Graphically, it stressed speed and efficiency, in accordance with

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the principles of the "New Building" and the "New Typography".[13] Throughout the book, Neufert presented design practice in a way that promoted time-, energy-, and money-saving habits. Neufert acclimated readers to the principle that DIN could and should serve as an authority on design-related matters: "The German Committee on Standards made available their norm sheets, which are selectively interwoven"[14], he wrote in the preface. Between 1938 and 1941, Neufert headed the Neufert Department ("Abteilung Neufert") within the GBI's General Construction Office. When the Department closed in December 1941, he subsequently became Speer's Consultant for Standards Questions ("Beauftragter für Normungsfragen"). He worked for Speer as a private contractor, albeit one who still had considerable access to the halls of power. During World War II, he oversaw the development of standard-dimensioned model floor plans ("Typen") and construction schemes for a variety of building types. Importantly, he was also tasked with managing the energies and efforts of workers on the construction site. By around 1941, the vast majority of these workers consisted of forced laborers and slave laborers – what Neufert sometimes called "untrained labor power" ("ungeübte Arbeitskräfte"). Between around 1938 and 1945, their ranks included prisoners-of-war, political dissidents, conscripted foreign nationals, concentration camp prisoners, and a host of others. Their situation posed a number of significant managerial challenges to Neufert, Speer, and the GBI. These problems will be used in this essay to contextualize the forces that prompted the adoption of "Widerspruchsfreiheit" as a policy within the construction industry. I will use them to explain why this principle grew in importance after World War II. Indeed, few slave laborers and forced laborers could speak German. They were also compensated poorly, if at all, and subject to torture as well as physical abuse, which harmed their productivity levels. They were starved or murdered at alarming rates, which devastated morale. Builders tended to receive inadequate training within the labor camps, which complicated the task of supervision. The armaments industry typically had priority as far as selecting workers, which limited the availability of skilled laborers. Housing conditions were abysmal, and the walk from one's living quarters to the construction site or factory was typically measured in kilometers, which meant that a lot of energy was wasted performing tasks that had nothing to do with construction. Slave laborers lacked the right to have rights – their circumstances resembled that of "homo sacer," as Giorgio Agamben might say– which placed appeals to economic self-interest beyond reach. "Scientific managers" such as F. W. Taylor believed that wage increases should accompany the application of time-saving principles on the factory floor; needless to say, the Nazis did not give much credence to this idea, indebted to Taylor though they were. Systemic racism likely biased performance assessments, which made the task of gathering data and planning reliable work schedules exceedingly difficult. Coalitions of competing interests managed the majority of construction efforts – in-fighting was common among senior Nazi officials – which hampered communication between designers, foremen, fabricators, and workers. After 1941, allied bombings interrupted work on a regular basis, which made systematic planning and coordination of the construction site difficult. Tools were in short supply, which harmed output. During the first half of World War II, construction practices varied significantly within the military – the "Heer", the "Luftwaffe", and the "Kriegsmarine" often developed standards independently of one another – which made the routinization of building practices nearly impossible. Corporations were not convinced that prisoners could be trusted to build their factories and man their assembly lines. This is because it was in the self-interest of prisoners to commit sabotage. As Speer later explained, "No sooner had the first foreign workers began arriving in the factories than I began hearing protests from our Industry Organization. They had a

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number of objections to make. The first was as follows: The technical specialists now being replaced by foreigners had occupied key posts in vital industries. Any sabotage in these plants would have far-reaching consequences. What was to prevent enemy espionage services from planting agents in (...) contingents?"[15]

Neufert addressed the questions above in a series of essays and books that appeared between 1939 and 1943. One of his most important was titled "Baunormung als Ganzheit", which translates roughly as "The Total Standardization of Construction". It appeared in 1942 in the journal "Bauindustrie", and it began with the following observation: "Until now, the standardization of construction has proceeded in an arbitrary fashion. The standardized dimensions of individual building components, windows, doors, stones, etc. are not coordinated with one another and are not compatible with one another".[16] Neufert noted that "one" building module predominated in the steel industry. It was called the Industrial Building Module ("Industriebaumaß" or "IBA"), and it set axial distances at 2.5 m.[17] Neufert developed it between 1938 and 1940 in collaboration with representatives of the steel industry, and he used it to rationalize the fabrication and construction of airplane factories, hangars, and other such structures for the "Luftwaffe". A second module governed the manufacturing of the majority of the "Reich's" barrack structures. It was known euphemistically as "RAD-Baracke", and its basic module measured 1.1 m. A third module governed the construction of masonry buildings. It based itself on the so-called "Reichsformat", a brick standard that was introduced in the early 1860s. The "Reichsformat" was developed with Imperial units (id est, feet) in mind. This was problematic because Germany had long since adopted the Metric system, making errors in the construction of masonry structures all the more common.

Neufert argued in his 1942 essay that the building of steel, timber, and brick structures ought to be harmonized. In essence, what the construction industry needs, he reasoned, is "Widerspruchsfreiheit". The Americans were already experimenting with these ideas, mostly because of the efforts of Albert Farewell Bemis, and the Germans, Neufert seemed to suggest, needed to follow its lead. Compatible dimensional units should govern the design of industrial and monumental buildings, factories, social housing, and barrack structures, he argued. This is because doing so was going to save money and increase quality: "After dealing with questions of standardization for many years and the standardization of construction in particular, I see therefore in the system of modular coordination proposed here a 'Baunormung als Ganzheit' as the only consistent foundation with practical, economic and cultural meaning over the long term."[18] Grids should be utilized by engineers and building component manufacturers, he asserted. This is to increase precision and reduce tolerances. The designer's grid should be reproduced at full scale on the construction site – the coordinates of these grids should dictate the arrangement of posts, trusses, and paneling systems. This is to improve precision levels on the construction site, enhance the foreman's ability to verify accuracy quickly and efficiently, and facilitate better communication between foremen and workers.

A unit of measurement known as an octameter, Neufert maintained, should dictate standard brick sizes. It was based on a module measuring 12.5 centimeters (1/8th of a meter), and Neufert first formulated it while working at the GBI. It approximated the dimensions of the "Reichsformat" (it was 24 centimeters long rather than 25), and it was also based on the metric system, which meant two things: it could readily be exported to occupied countries (the metric system was by this time in use throughout most of Continental Europe). It could also be used in conjunction with the older brick sizes. The octameter allowed contractors and workers to measure room dimensions in bricks rather than meters, thus saving time. It simplified the task of communicating with non-German-speaking workers, which, as suggested, was useful given the multiethnic composition of Nazi Germany's labor population. It eased the task of

calculating measurements, which was important given the time constraints that were often involved. Each octametric brick had a slender profile, which, according to Neufert, made its proportions aesthetically pleasing. The octameter was compatible with IBA, which simplified the task of utilizing masonry and steel building systems together: "Since industrial buildings are executed virtually without exception as masonry block shells, so [under this system] would the brick association govern the remaining window sizes regarding the remaining posts."[19] Neufert believed that a 1.25-meter module, which he sometimes dubbed the Shelter Building Module ("Unterkunftsbaumaß" or "UBA"), should dictate the dimensions of barrack structures. These should be modeled after predecessors developed by the Bureau of the Beauty of Labor (Amt "Schönheit der Arbeit"), he believed, particularly the so-called Shelters for Construction Workers ("Wohnunterkünfte für Bauarbeiter"), which were developed for autobahn workers during the 1930s. He also argued that IBA (the 2.5-meter module described earlier) should continue to govern factory construction. This was to foster the use of interchangeable parts on all construction sites throughout occupied Europe. 2.5 m (or 1 IBA) divided by two is 1.25 m (or 1 UBA). 1 octameter is 1/10th of 1 UBA or 1/20th of 1 IBA.

Using his system, Neufert believed that office managers would be able to calculate costs more efficiently. This was important because the management of the building industry was highly centralized: "An essential advantage of such a systematic standardization is also the systematic determination of costs for the utilization of basic building components, such as windows and doors. After the dimensions of panels, profile sizes and processing requirements are determined it will be easy to negotiate prices so that one can better understand the breadth of work being done".[20] Government bureaucrats could more accurately forecast shipping costs: "Considering the various distances between the building site and the location where fabrication takes place, freight costs and delivery costs from the train station to the construction site, as well as the manufacturing of structural connections, can be assessed."[21] The incidence of structural defects and the training of workers would also become less onerous. "My proposal", Neufert wrote, "facilitates simplified police inspection through the usage of preexamined structural calculation systems and guarantees freedom from error ["Fehlerfreiheit"] since many people have tested it in advance and executed it in practice."[22]

Neufert was convinced that "Widerspruchsfreiheit" – and the attendant use of interconnected grid systems – opened the door to the total mechanization of the building process. This is because it increased the control that construction managers wielded over workers. It enforced specialization and facilitated the synchronization of people and things. It optimized the state's ability to exploit available labor power, in part because it normalized the usage of the assembly line and other tools that regulated productivity. "So an entire city can be built with little, unskilled labor power in three-shifts, day and night (...) based on a mechanized, pre-set fabrication tempo, during summer as well as winter, protected from sun or eastern snow and frost."[23] The mechanization of the construction industry was going to increase productive output, Neufert believed, much like Ford's Rouge automobile assembly facility. It was also going to enforce the use of time-saving managerial practices, he felt. "The industrial mass production of quality machinery, automobiles, etc., has shown that quality does not suffer under such an enforced speed, if the necessary machines are available and the fabrication pace is synchronized with the fatigue levels of the workers (Taylor System)."[24]

In practice, Neufert's proposal for the mechanization of construction never came to fruition. His system of total standardization was only partially realized as well. "Operation Barbarossa" (i.e., Nazi Germany's invasion of the Soviet Union) halted plans to standardize the octametric brick and precipitated the partial dismantling of the GBI's "Generalbauleitung".

Speer dispatched Neufert's supervisor Brugmann to the Ukraine, where he was eventually killed. Neufert found himself embroiled in a massive power struggle, one that reached the very highest levels of government. As one official noted in an internal memorandum, "[u]nder no circumstance will we throw in our lot with Mr. Neufert, whose designs for emergency dwellings have also been rejected by the 'Führer' due to their foolish proportions."[25] Still, it needs to be emphasized that Neufert's ideal of total standardization did gain currency in a number of ways. Speer's Research Collective for Armamentation ("Erfahrungsgemeinschaft für Rüstungsausbau") used it to develop DIN 4171, which industrialized the building of barracks and factories. Neufert belonged to the committee that ratified it, and he probably also played a role in drafting the proposal on which it was based. Neufert later wrote that "18 members of the committee voted for DIN 4171, and only two were opposed to it"[26]. DIN 4171 facilitated the systematic standardization of timber and steel fabrication components. It helped make technical consistency and vertical integration an administrative priority within the building industry. It undercut the dominance of the RAD barracks, which, as noted, ran into conflict with IBA and Neufert's octameter. It prompted a wave of decrees that made Neufert's system of standardization binding for a number of government ministries.
During the second half of World War II, most but not all barrack types within the "Reich" recognized DIN 4171. The so-called BfH barrack type was "manufactured with a building depth of 5 m, 7.5 m, 10 m, 12.5 m and 15 m, a panel width of 1.25 m, a ceiling height of 2.75 m and 3.25 m. The BfH barrack type can be delivered with a minimum length of 1.25 m and at any length as long as it is a multiple of 1.25 m. "[27] The FLA barrack type, "had a building depth of 5 m, a ceiling height of 2.25 m, a minimum length of 2.5 m and could be lengthened in units of 1.25 m."[28] Although barrack type OKH 260, the infamous "horse stall" barrack, was based on a 1.5 m system of modular coordination, Neufert suggested that it could readily be reformatted to accommodate DIN 4171. "On page 17 [of his book] Schubert offers stall widths for standard field and work horses excluding the nursery at 2.5 m and including the nursery and gangway at 5 m (in accordance with the Decree of 1896). According to that logic, two rows next two each other with ≤ 8.5 m depth can be anticipated, which coincides with an axial distance of 8.75 m = 7 UBA (Industrial Building Module)."[29]
Speer used DIN 4171 to calculate the storage of people in camp barracks. This proved important where the Nazis' racial policies were concerned. It ensured that Christians slept more comfortably than Jews and that Dutch or English prisoners had more space to themselves than Russians or Poles. In general, Russian prisoners typically slept in abysmally cramped quarters, on double or triple-tiered bare wooden bunks, while non-Jewish and non-Russians prisoners sometimes slept on beds with mattresses. For RAD Barrack Type RL IV (RAD-Mannschaftsbaracke Typ RL IV), Speer announced that "each unit containing 18 civil laborers or non-Russian prisoners of war" should have "9 double-beds and 9 double-closets."[30] Meanwhile, "[t]o accommodate 36 Russian prisoners of war (...) beds are to be fabricated on-site and arranged as wood plank bunks."[31] It is probable that Speer and his associates used DIN 4171 to synchronize the dimensions of individual furnishings with those of barrack structures, as per Neufert's instructions. They probably also used it to maximize the storage of people vertically and horizontally in space. Effectively, they used it to transform the barrack into a weapon of destruction rather than merely an instrument of shelter. As Neufert put it, "[i]t is important to note that this system serves and helps to coordinate the sizing of the structural work, interior, and furnishings of each building."[32]
Between 1942 and 1944, Neufert incorporated DIN 4171 into the "Bauentwurfslehre". "IBA and UBA axial dimensions were adopted", he notes in the preface to the 1942

edition.[33] This popularized awareness of "Widerspruchsfreiheit", albeit in a discrete and informal way. Neufert based the dimensions of the standard-dimensioned green house on the Industrial Building Module. He also used it to revise the pages of the book that were devoted to factory buildings. The width of a bay carrying a standard-width overhead crane shrank from 30.8 m in the March 1936 edition to 30 m in the 1943 edition.[34] The distance separating two bays in a saw-tooth factory grew from 7 m in the 1936 edition to 7.5 m in the 1942 edition.[35] In the 1943 edition of the "Bauentwurfslehre", the dimensions of model school designs were based on a 1.6 m module; in the 1944 edition, by contrast, they were based on a 1.25 m module, in keeping with DIN 4171.

The Organisation Todt used DIN 4171 to standardize the buildings of thousands of bunkers; the German Labor Front used it to develop low-cost housing solutions for German families who had been displaced by Allied bombings. Robert Ley (Reichskommissar for social housing) commissioned Neufert to use DIN 4171 to design "Kriegseinheitstypen", which were two-story, sixteen unit walk-up apartments, with two main entrances and double-loaded corridors. Intimately connected to Neufert's "Behelfsunterkünfte für Bombenbeschädigte", these wooden structures were built using a prefabricated paneling system. With pitched roofs, shuttered windows, and symmetrical façades, they were developed with vernacular tastes in mind, and they normally consisted of two or three rooms, plus a kitchen and bathroom. Here, Neufert used DIN 4171 to determine panel sizes, as well as the angling of gables and the interior space planning scheme. DIN 4171 underpinned the fabrication of the plumbing and electrical components. It influenced the design of the work schedule and budget calculations. Neufert used DIN 4171 to quantify individual tasks and minimize reliance on skilled labor on the construction site; he also used it to maximize efficiency where shipping was concerned (Fig. 3).

In 1943 and again in 1944, Speer's Construction Industry Group ("Wirtschaftsgruppe Bauindustrie") and his Working Group for Temporary and Military Structures ("Arbeitsgemeinschaft für Behelfs- und Kriegsbau") used DIN 4171 to develop a prefabricated concrete barrack type (Fig. 4). These prefabricated structures were known as Massive Barrack Units ("Einheits-Massivbaracken"), and they were introduced to offset the problems that the timber shortage in Nazi Germany posed to the housing of prisoners and soldiers. "Until now", the designers of this new barrack type wrote, "(...) there were only a few experiments undertaken by individual firms for the development of massive shelters that could be brought to production. These solutions, however, were ill-suited for accommodating workers. Furthermore, they utilized very specific materials, for example pumice, which were only available in specific regions. Finally, they relied only partly on Prof. Neufert's (the General Building Inspector's Contractor for Standardization) 1.25 m module, which was originally intended for temporary housing schemes."[36]

The Massive Barrack Units were available as single-story or two-story structures. They were panel-based shelters, and it is possible that they were fabricated at the Neuengamme concentration camp: "For the saving of formwork and to limit storage requirements it was mandated that [this structure] will be developed with as few individual pieces as possible. The load-bearing structure consists of 11 or rather 10 individual pieces."[37] Each panel was quite heavy (sometimes upwards of 200 kg) despite the fact that they were handled by hand. This probably made them impractical to execute: "In order to make it possible to load and unload concrete components from trucks using four laborers without the use of a crane, the highest weight of an individual piece was calculated to be around 200 kg."[38]

By 1944, DIN 4171 became all but synonymous with the idea of "Widerspruchsfreiheit", at least within the construction industry. We can assume that it paved the way for the creation of the Commission for Standardization and Typification

("Kommission für Normung und Typung"), which Speer created to amplify his influence over DIN as well as to centralize his control over the building industry as a whole. Its mandate included the following objectives: "1. To plan standardization and typification and their implementation from a unified perspective. 2. To issue guidelines for the creation of standards. 3. To contract suited individuals to carry out the realization for specific standards. 4. To harmonize all standards with the principle of "Widerspruchsfreiheit".[39] In general, the Commission gave DIN's senior leaders executive authorities that they lacked for much of the war. If fully realized, it would have institutionalized Neufert's totalizing vision of standardization. Neufert probably played a seminal role in its creation. Speer appointed him head of DIN's powerful "Leitstelle Bau" or Construction Committee in 1944; he also helped him become a member of DIN's presidium.

Speer's Commission was disbanded in 1945, once the Nazis fell from power. DIN surrendered its decision-making powers, at least for a time, and Neufert lost his seat on DIN's presidium. Nevertheless, "Widerspruchsfreiheit" became enshrined within DIN's Construction Standards Committee. This is partly because members of the GBI, Organisation Todt (OT), and the SS continued to occupy senior positions within it. Germany stood in shambles after World War II, and there was broad consensus that reconstruction needed to happen quickly and expeditiously as well. After World War II, DIN 4171 had a massive impact on the dimensioning of prefabricated wood panels and steel building components, paving the way for the ratification of DIN 4172.[40] It prompted the adoption of standards for roof slopes and hollow-core slabs, and later proved crucial to the subsequent history of prefabricated timber housing in Germany. According to Neufert, there were 1,553 prefab housing unit choices available to the West Germany consumer in 1962. Of those, just over half of them recognized DIN 4171.[41] DIN 4171 was renewed at least twice during the course of the 1950s. It impacted the standardization of lot and street dimensions in West Germany: "In [the standard sheet known as DIN 4171] it was specified that axial distances should stand at 2.5 m", he later wrote, "in the design of land-use plans, the delimitation of property lengths and widths, the measuring of spacing between buildings, front yard and courtyard sizes, building setbacks, street widths and other things are already based on the Industrial Building Module (of 2.5 m), depending on the size of the property or the desired precision of the grid that gets used."[42] DIN officially withdrew DIN 4171 during the early 1970s, yet it continues to influence manufacturing and design practices inside Germany today. My own informal surveys suggest that 1.25 m remains the most widely used grid module among German architects. Interestingly, it is no longer associated with industrial buildings and temporary shelters alone.

Looking back, it is clear that West Germany's postwar construction industry was a product of wartime influences: the Four-Year Plan, as already noted, and Speer's fanatical obsession with standardization and rationalization. Standard sheets gave the National Socialists a language that they could use to communicate with their counterparts in private industry. Standards helped them develop the incentive mechanisms that they could use to cultivate the loyalty of large corporations. It was crucial to their labor policies: for slave labor played a huge role in influencing the rise of scientific management theory in the United States, as Caitlin Rosenthal has argued.[43] Similarly, Nazi Germany's experience with slave labor and forced labor shaped its attitudes toward standardization and rationalization during World War II as well. The enduring influence of DIN 4171 and 4172 bear out this influence, as does the dominance of "Widerspruchsfreiheit". Manufacturers used these tools to contain labor costs. Importantly, DIN 4171 and 4172 also played a role in normalizing the use of grid systems. They belong to the design of design, and they continue to influence the way architects understand design practice today.

Picture credits

Fig. 1: Erfahrungsgemeinschaft für Rüstungsausbau beim Reichsminister für Bewaffnung und Munition: DIN 4171. Einheitliche Achsenabstände für Werksbauten, Industrie- und Unterkunftsbauten, Berlin, October 1942.

Fig. 2: Fachnormenausschuß Bauwesen im Deutschen Normenausschuss: DIN 4172. Maßordnung im Hochbau, Berlin, January 1951.

Fig. 3: Ernst Neufert, Behelfsunterkünfte für Bombenbeschädigte Holzhausbauweise, 1943. Bundesarchiv R 4002/126 Bl. 2.

Fig. 4: Arbeitsgemeinschaft für Behelfs- und Kriegsbau in der Fachgruppe Bauwesen im NSBDT und der Wirtschaftsgruppe Bauindustrie (ed.): Einheits-Massivbaracke und Mittelflur-Sondermassivbaracke, Berlin, 1944, p. 35.

Notes

1 This paper was originally presented in March 2016 at the conference "Ähnlichkeit: Prozesse und Formen. Mimetische Praktiken in der neueren Architektur" at the Stiftung Bibliothek Werner Oechslin in Einsiedeln (Switzerland). The author wishes to thank the organizers of the event – Hans-Rudolf Meier, Eva von Engelberg-Dočkal, Carsten Ruhl, Frederike Lausch, Werner Oechslin, and especially Markus Krajewski – for their kind support and generous feedback. It was a stimulating meeting from which I profited a great deal.

2 See, for example, Evans, Robin: Translations from Drawing to Building, Cambridge/Massachusetts 1997.

3 All translations from the original German are by the author unless noted otherwise. "Die Mitarbeiter von DIN organisieren die Normungsarbeit auf deutscher, europäischer und internationaler Ebene. Sie stellen die Einheitlichkeit und Widerspruchsfreiheit des Deutschen Normenwerkes sicher.": http://www.din.de/de/ueber-normen-und-standards/din-norm (Accessed 05/04/2013).

4 "Für Industriebauten gilt für die Achsenabstände ein einheitliches Grundmaß von 2,5 m [...]. In Sonderfällen kann für die Achsenabstände auch das halbe Grundmaß von 2,50/2 = 1,25 m oder ein Vielfaches davon zur Anwendung kommen.": Deutscher Normenausschuss: DIN 4171. Einheitliche Achsenabstände für Werksbauten, Industrie- und Unterkunftsbauten, Berlin 1942.

5 "Baurichtmaß: Baurichtmaße sind zunächst theoretische Maße; sie sind aber die Grundlage für die in der Praxis vorkommenden Einzel-, Rohbau- und Ausbaumaße. Sie sind nötig, um alle Bauteile planmäßig zu verbinden. Beispiel: Baurichtmaß für Länge des Mauerziegels = 25 cm. Baurichtmaß für Dicke geschütteter Betonwände = 25 cm.": Fachnormenausschuß Bauwesen im Deutschen Normenausschuss: DIN 4172. Maßordnung im Hochbau, Berlin 1951.

6 "Über die Ziele der Normung auch im Bauwesen waren sich 1918 viele Fachleute durchaus nicht klar. In der Regel wurde als letztes Ziel betrachtet: nur noch ein Türschloß, nur noch eine Reihe Schrauben, schließlich nur noch ein Haus, wenigstens nur ein Muster für jede Bedarfsgruppe. Das waren Zerrbilder, mit denen die Beteiligten scheu gemacht werden sollten.": Paulsen, Friedrich: 20 Jahre deutsche Hochbaunormung. Rückblick und Ausblick, in: Bauwelt 15, 1938, p. 334.

7 Evans, Richard: The Third Reich in Power, New York 2006, p. 370.

8 Speer, Albert: Inside the Third Reich, New York 1970, p. 74.

9 "Seit dem zweiten Kriegsjahr machte eine Reihe kriegswichtiger Sonderaufgaben einen Großteil der Tätigkeit des GBI aus: der Rüstungsbau, der Luftschutzraumbau, die Fliegerschädenbeseitigung und der Einsatz von Baugruppen für die Organisation Todt. Im November 1939 übernahm Speer die Leitung der Rüstungsbauten der Luftwaffe, im Juli 1941 die der Industriegroßbauten des ‚Göring-Programms.' Einzelne Aufträge der Heeresleitung und der Kriegsmarine kamen hinzu. Zu Beginn des dritten Kriegsjahrs waren die im Baustab Speer zusammengefaßten Baugruppen des GBI an 1.352 Bauvorhaben der Luftwaffe und des U-Boot-Programms und an 83 großen Werksneubauten eingesetzt.": Willems, Susanne: Der Entsiedelte Jude. Albert Speers Wohnungsmarktpolitik für den Berliner Hauptstadtbau, Berlin 2002, p. 40.

10 "Die Generalbauleitung ist für die Beschaffung der notwendigen Materialien (Werksteine, Backsteine usw.) mir direkt verantwortlich [...]. Die Zuweisung von Bauarbeitern an die einzelnen Baustellen kann die Generalbauleitung direkt vornehmen lassen.": Speer, Albert: Aufgaben der Generalbauleitung Berlin, den 22. Juli 1940, Bundesarchiv 4/4606/4008.

11 For a discussion of Neufert's politics, see Voigt, Wolfgang: "Triumph der Gleichform und des Zusammenpassens": Ernst Neufert und die Normung in der Architektur, in: Nerdinger, Winfried (ed.): Bauhaus-Moderne im Nationalsozialismus: Zwischen Anbiederung und Verfolgung, Berlin / München 1993, pp. 179–193.

12 "Grundlage, Normen und Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen [und] Maße für Gebäude, Räume, Einrichtungen und Geräte mit dem Mensch als Maß und Ziel.": Neufert, Ernst: Bauentwurfslehre, Berlin 1936, title page.

13 For a discussion of the typographical aspects of the „Bauentwurfslehre", see Vossoughian, Nader: Standardization Reconsidered: Normierung in and after Ernst Neufert's Bauentwurfslehre (1936), in: Grey Room 54, 2014, pp. 34–55. For a discussion of the „Bauentwurfslehre" and the standardization of Germany's construction industry more broadly, see Vossoughian, Nader: From A4 Paper to the Octametric Brick: The Geopolitics of Standardization in Nazi Germany, in: Journal of Architecture 20, 2015/4, pp. 675–698. For a comparison of the "Bauentwurfslehre" with other architectural handbooks, see Emmons, Paul / Mihalache, Andrea: Architectural Handbooks and the User Experience, in: Cupers, Kenny (ed.): Use Matters: An Alternative History of Architecture, London 2013, pp. 36–50. For an overview of Neufert's life and career, see Prigge, Wolfgang (ed.): Ernst Neufert: Normierte Baukultur im 20. Jahrhundert, Frankfurt/Main 1999.

14 "Der Deutsche Normenausschuß stellte die Normenblätter zur Verfügung, die auszugsweise in gekürzter oder gedrängter Form eingeflochten sind.": Neufert 1936 (as footnote 12).

15 Speer 1970 (as footnote 8), p. 22.

16 “Die bisherige Baunormung erfolgte im Allgemeinen beziehungslos. Die genormten Abmessungen der einzelnen Bauteile, der Fenster, Türen, Steine, usw. haben miteinander kein Maßverhältnis und gehen nicht ineinander auf.”: The version of the text cited here appeared in leaflet form: Neufert, Ernst: Baunormung als Ganzheit, in: Bauindustrie 37/38, 1942, p. 1.

17 Neufert was central to the execution of this project: “Prof. Speer beauftragte mich seinerzeit als Industrieplaner, hiefür bestimmte Hallentypen mit einheitlichen Bauteilen auszuarbeiten. Er gab ganz klare Richtlinien über die Ziele dieser Hallentypisierung, die schnell den Kriegserfordernissen entsprechend aufgebaut werden mußten, um ihren Zweck voll erfüllen zu können.”: Neufert, Ernst: Bauordnungslehre, Amsterdam 1943, p. 97.

18 “Nach jahrelanger Beschäftigung mit Normungsfragen und der Baunormung im besonderen, sehe ich deshalb in den vorher entwickelten Maßsystemen einer Baunormung als Ganzheit die einzige konsequente Grundlage mit praktischer, wirtschaftlicher und kultureller Bedeutung auf weite Sicht.” Neufert 1942 (as footnote 16), p. 4 .

19 “Da Industriebauten fast ausnahmslos als Klinker- und Ziegelrohbauten ausgeführt werden, so wurde die Paßfähigkeit des Steinverbandes der Fenster resp. der übrigbleibenden Wandpfeiler genau ermittelt.”: Neufert 1942 (as footnote 16), p. 1.

20 “Ein wesentlicher Vorteil der so weitgehenden Normung ist auch die weitgehende Festlegung der Kosten für die zum Ausbau des Rohbaues nötigen Bauteile, wie Fenster und Türen. Nachdem die Abmessungen der Scheiben, Profilgrößen und Verarbeitungsvorschriften im einzelnen feststehen [...] ist es daher leicht, auch die Preise zu vereinbaren, um den Umfang der Leistungen genau zu erfassen.”: Neufert 1943 (as footnote 17), p. 314.

21 “Dabei werden die Rücksicht auf die verschiedenen Entfernungen des Bauwerkes vom Bauteilfertigungsort und die Frachtkosten besonders vergütet, ebenso die Anfuhrkosten vom Bahnhof zur Baustelle, wie auch die Herstellung der Befestigungsmöglichkeit an der Baukonstruktion.”: Neufert 1943 (as footnote 17), p. 314.

22 “vereinfachte Baupolizeigenehmigung durch baupolizeilich vorgeprüfte stat. Berechnungen und Fehlerfreiheit aus der Tatsache der mehrmaligen Vorprüfung und der mehrmaligen Ausführung.”: Neufert, Ernst: Industriehallennormung beim Generalbauinspektor für die Reichshauptstadt, in: Der deutsche Baumeister 2:3, 1940, p. 33.

23 “So kann eine ganze Stadt von wenigen, eingearbeiteten, ungelernten Kräften im Dreischichtenbetrieb, Tag und Nacht [...] errichtet werden, ganz im mechanischen, festgelegten Fertigungstempo, Sommer wie Winter, geschützt vor sengender Sonnenglut oder östlichen Schnee und Frost.”: Neufert 1943 (as footnote 17), p. 467.

24 “Die industrielle Massenherstellung von Qualitätsmaschinen, Fahrzeugen usw., hat gezeigt, daß durch solch zwangsläufiges Arbeitstempo die Qualität nicht leidet, wenn die nötigen Hilfsmaschinen und Vorrichtungen gegeben werden und das Fertigungstempo den Ermüdungserscheinungen der Arbeiter angepaßt wird (Taylor-System).”: Neufert 1943 (as footnote 17), p. 457.

25 “Wir wollen uns keinesfalls für Herrn Neufert einsetzten, da dessen Entwürfe für Notwohnungsbauten auch der Führer der törichten Maße wegen ablehnt.”: Memorandum, August 18, 1943, Bundesarchiv VBS 307/8200002119.

26 “Tatsache ist, daß 18 Ausschußmitglieder für den Entwurf der ‚DIN 4171’ stimmten, dagegen aber nur zwei.”: Neufert, Ernst et al.: Offener Brief an Professor Neufert und eine offene Antwort von Professor Neufert zur Maßordnung, in: Neue Bauwelt 4:5, 1945, p. 67.

27 “BFH-Type. Die BfH-Baracke wird hergestellt mit einer Gebäudetiefe von 5m, 7,5m, 10m, 12,50m und 15m, einer Tafelbreite von 1,25m, einer Raumhöhe, von 2,75 m und 3,25 m. Die BfH-Baracke kann in einer Mindestlänge von 1,25 m und in beliebiger Verlängerung um jeweils weitere 1,25 geliefert werden.“: Steffens [no first name given]: Durchführungsbestimmung zur 32. Anordnung. Reichsminister Speer, June 23, 1943, Thüringisches Hauptstaatsarchiv Weimar, Thür. Finanzmin. Nr. 989, Bl. 14v–16v.

28 “Die Baracke wird mit einer Gebäudetiefe von 5,00 m, einer Raumhöhe von 2,25 m, in einer Mindestlänge von 2,5 m, und in beliebiger Verlängerung um 1,25 m geliefert.”: Steffens 1943 (as footnote 27).

29 “Schubert gibt auf Seite 17 die Standlänge für normale Acker- und Arbeitspferde ausschließlich Krippe mit 2.5 m an und einschließlich Krippe und Stallgasse mit 5 m (entsprechend dem Erlaß von 1896). Danach sind 2 Reihen hintereinander mit ≤ 8.5 m Raumtiefe vorzusehen, was einem Achsenabstand der Außenwände von 8.75 m = 7 UBA entsprechen würde.”: Neufert 1943 (as footnote 17), p. 350.

30 “je Einheit bei Belegung mit 18 Zivilarbeitern oder nichtrussischen Kriegsgefangenen: 9 Mannschaftsdoppelbetten, 9 Mannschaftsdoppelschränke”: Reichsminister Speer: “26. Anordnung,” April 17, 1942. Thüringisches Hauptstaatsarchiv Weimar, Thür. Finanzmin. Nr. 988, Bl. 45r.

31 “Bei Belegung mit 36 russischen Kriegsgefangenen (Betten sind als 2-stöckige Pritschen örtlich anzufertigen)”: Speer, Albert: 26. Anordnung, April 17, 1942, Thüringisches Hauptstaatsarchiv Weimar, Thür. Finanzmin. Nr. 988, Bl. 45v.

32 “Wichtig ist, darauf hinzuweisen, daß dieses System dem Rohbau, dem Ausbau und der Einrichtung in gleicher Weise dient.”: Neufert 1943 (as footnote 17).

33 “IBA und UBA Achsensystem aufgenommen.”: Neufert, Ernst: Bauentwurfslehre, Berlin, 1942, p. 3.

34 Neufert, Ernst: Bauentwurfslehre, Berlin 1943, p. 189.

35 Ibid., p. 189.

36 “Bisher lagen nur wenige Versuche einzelner Firmen für massive Unterkünfte vor, die sich jedoch teilweise bereits in der Praxis bewährt hatten. Diese Lösungen stellten vielfach einen für Arbeiterunterkünfte ungeeigneten Typ dar. Ferner gingen sie zumeist von ganz bestimmten, nur örtlich vorhandenen Baustoffen wie z. B. Bims oder dgl. aus. Endlich legten sie nur teilweise das von Prof. Neufert (Beauftragter für Normungsfragen des Generalbauinspektors) entwickelte und für alle behelfsmässigen Kriegsbauten festgelegte Achsmaß von 1,25 m zu Grunde.”: Arbeitsgemeinschaft für Behelfs- und Kriegsbau in der Fachgruppe Bauwesen im NSBDT und der Wirtschaftsgruppe Bauindustrie (ed.): Einheits-Massivbarracke und Mittelflur-Sondermassivbaracke, Berlin 1944, p. 3

37 “Zur Einsparung von Schalungsformen und zur Einschränkung der Lagerhaltung war es geboten, mit möglichst wenig verschiedenen Einzelteilen auszukommen. Das Traggerippe besteht aus 11 bzw. 10 Einzelteilen.”: Ibid., p. 9.

38 “Um das Auf- und Abladen der Betonfertigteile auf und von Fahrzeugen durch 4 Arbeitskräfte ohne Einsatz besonderer Hebezeuge zu ermöglichen, wurde das Höchstgewicht des einzelnen Stückes mit rd. 200 kg festgelegt. Dieses Höchstgewicht wird nur bei den Sparren erreicht; es bleibt bei allen anderen Teilen weit unter dieser Höchstgrenze.”: Ibid., p. 10.

39 “Die Normung und Typung zu planen und ihre Durchführung nach einheitlichen Gesichtspunkten sicherzustellen. 2. Richtlinien für die Aufstellung der Normen herauszugeben. 3. Geeignete Normungsträger mit der Aufstellung von Normen zu beauftragen. 4. Für die Abgleichung aller Normen auf Widerspruchsfreiheit zu sorgen”: Speer, Albert: Erlaß betreffend Lenkung der Normung und Typung, in: Mitteilungen des Deutschen Normenausschusses 26:6/7, 1944, p. 137.

40 See Vossoughian 2015 (as footnote 13), pp. 675–698.

41 Neufert, Ernst: Das Maßgebende, Bauverlag 1965, p. 21.

42 “Für den Industriebau wurde im Juni 1955 die DIN 4171 veröffentlicht. Darin wurde festgelegt, dass für Achsenabstände im Industriebau das Grundmaß von 2,50 m gilt. Schon bei der Aufstellung von Bebauungsplänen, Begrenzungen der Grundstückslängen und -breiten, Bemessung von Bauwich, Vorgartenbreite, Hofgröße, Bauabstand, Straßenbreite und anderen, die Bebaubarkeit des Grundstücks betreffend Maßen sind die IBA-Maße als Richtmaße anzusetzen, je nach der Größe des Geländes oder der erwünschten Feinheit des Grundstücksrasters.”: Heymann-Berg, Joachim P. / Netter, Renate / Netter, Helmut (eds.): Neufert, Ernst: Industriebauten, Wiesbaden, Berlin 1973, p. 301.

43 See Rosenthal, Caitlin: Slavery’s Scientific Management: Masters and Managers, in: Beckert, Sven / Rockman, Seth: Slavery’s Capitalism: A New History of American Economic Development, Philadelphia 2016.