Ruth Woods • Lars Gullbrekken

SINTEF
NOTAT
19

Overhalla bolig: Rimelig oppgradering av kommunal bolig i samarbeid med videregående skole

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Forord

Gjennom prosjektet *Overhalla bolig: Rimelig oppgradering av kommunal bolig i samarbeid med videregående skole* har Overhalla kommune, Olav Duun videregående skole, SINTEF og lokal byggenæring samarbeidet om oppgradering av en tomannsbolig fra 1972 til passivhusstandard og om en kursserie for elever fra byggfag, elektrolinje og helse- og oppvekstfag. Overhalla kommune har hatt prosjektledelse for byggeprosjektet, og Trønderplan AS har vært ansvarlig arkitekt. SINTEF Byggforsk har vært engasjert gjennom et toårig prosjekt finansiert av Husbanken.

Hovedfokuset i rapporten er gjennomføringen av kursserien som ble utviklet av SINTEF Byggforsk for elever fra Olav Duun videregående skole i Namsos. Rapporten gir en kort oversikt over temaene som har blitt undersøkt og aktivitetene som er gjennomført. Til slutt drøfter vi noen erfaringer fra prosessen. Temaene for kursserien i *Overhalla bolig* og for rapporten er oppgradering til passivhusnivå, universell utforming og beboermestring.

Snorre Wågø Solem og Fabian Ersøy Wold har lagd en film som presentere prosjektet og flere av de som har vært med i prosjektteamet. Filmen er tilgjengelig på både Husbankens og SINTEFs nettsider.

Prosjektet er utført av SINTEF Byggforsk ved Lars Gullbrekken, Kari Hovin Kjølle, Solvår Wågø og Ruth Woods. En stor takk til alle som har bidratt i prosjektet fra Overhalla kommune og Olav Duun videregående skole (både lærere og elever!). En ekstra stor takk til Husbanken som har finansiert prosjektet og bidratt med faglige innspill og oppmuntring underveis.

Trondheim, november 2016

Judith Thomsen
Forskningsleder
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Summary

The project *Overhalla housing: Affordable Upgrading of Municipal Housing in Collaboration with Secondary Schools* is a collaboration between Overhalla Municipality, Olav Duun Secondary School in Namsos, SINTEF and the local building industry. Pupils from building and electrical studies have upgraded two semidetached municipal houses from 1972 to passive house level, and pupils from health and social development studies have participated in activities aimed at increasing the quality of life and functionality found in social housing in the community. Overhalla Municipality was project manager for the building project and Trønder Plan AS was the responsible architect. SINTEF was engaged as a consultant and to develop the pedagogical program. The Norwegian Housing Bank funded the two-year project.

Earlier projects in Blakstad and in Åfjord have shown that cooperation between secondary schools and municipalities is a good solution to building affordable housing, to developing skills and knowledge and to creating a practical learning arena for secondary school pupils. Knowledge about passive house construction is growing, but recruitment to building studies in secondary schools is still poor. The market for small custom-built houses in municipalities is limited, but there is still a need for municipal housing that is more attuned to resident's requirements. The majority of the houses that society will need in the next 80-100 years already exist, but many of them are in need of upgrading. Social houses owned by municipalities also require upgrading. The main theme of the course series in the *Overhalla housing* project was therefore upgrading to passive house standard, universal design and resident inclusion.

The report provides a brief overview of the topics investigated and the activities carried out. Finally, we discuss some of the lessons learned.

Innhold

BILAG/VEDLEGG

To vitenskapelige artikler:

Gullbrekken, L., Woods, R. og Kjølle, K.H. (2015). *Overhalla Housing: Affordable retrofitting of municipal housing in partnership with Secondary Schools***,** NESS2015 Nordic Environmental Social Science Conference 2015: Contested Natures – new strategies, ideas and dialogues, Trondheim, Norway, 9–11th June 2015.

Woods, R. og Gullbrekken, L. (2016). *User Participation and Upgrading Municipal Housing in Partnership with Secondary Schools*, 4th Nordic Conference for Rural Research, University of Akureyri, Iceland, May 22–24, 2016

Innledning

Figur 1: Fra presentasjonen til konferansen *4th Nordic Ruralities*, mai 2015 (Teksten i bildet er oversatt fra engelsk til norsk.)

Prosjektet *Overhalla bolig: Rimelig oppgradering av kommunal bolig i samarbeid med videregående skole* er et samarbeid mellom Overhalla kommune, Olav Duun videregående skole, SINTEF og lokal byggenæring. Elever fra byggfag og elektrolinje har oppgradert en tomannsbolig fra 1972 til passivhusstandard, og elever fra helse- og oppvekstfag har deltatt i aktiviteter rettet mot å øke bokvaliteten og funksjonaliteten til omsorgsboliger i Overhalla. Overhalla kommune har hatt prosjektledelse for prosjektet, og Trønderplan AS har vært ansvarlig arkitekt. SINTEF har vært engasjert gjennom et toårig prosjekt finansiert av Husbanken.

SINTEF Byggforsk har gode erfaringer med å kurse lærere og elever i bygging av passivhus. Prosjekter på Blakstad og i Åfjord har vist at samarbeid mellom videregående skoler og kommuner er en god løsning både for å bygge rimelige boliger, for å utvikle kompetanse og kunnskap og for å skape en virkelighetsnær læringsarena for elever i videregående skole. Kunnskapen om passivhusbygging er økende, men det er fortsatt dårlig rekruttering til byggfag i videregående skoler. Markedet for å bygge små tilpassede eneboliger er begrenset, men det er behov for kommunale boliger som er mer tilpasset behovene til dagens beboere. Flertallet av de boligene som samfunnet vil trenge framover, er allerede bygd, men mange av dem har behov for oppgradering. Dette samsvarer med et økende behov for oppgradering av kommunale boliger. Hovedtemaet for kursserien i

Overhalla bolig er dermed oppgradering til passivhusnivå, universell utforming og beboermestring.

Rapporten gir en kort oversikt over temaene som har blitt undersøkt, aktivitetene som er gjennomført. Til slutt drøfter vi noen erfaringer fra prosessen.[1] Prosjektet er også presentert i en film lagd av elever fra linje for medier og kommunikasjon ved Byåsen videregående skole i Trondheim. Filmen er tilgjengelig på både Husbankens og SINTEFs nettsider.

Målsettinger og metodikk

Figur 2: Program for kursdagen 21.11.2014

[1] Prosjektet er også drøftet i to vitenskapelige artikler (se vedlegg): Woods, R., Gullbrekken, L. (2016) *User Participation and Upgrading Municipal Housing in Partnership with Secondary Schools*, 4th Nordic Conference for Rural Research, University of Akureyri, Iceland, May 22–24, 2016. Gullbrekken, L., Woods, R. og Kjølle, K.H. (2015) *Overhalla Housing: Affordable retrofitting of municipal housing in partnership with Secondary Schools***,** NESS2015 Nordic Environmental Social Science Conference 2015: Contested Natures – new strategies, ideas and dialogues, Trondheim, Norway, 9–11th June 2015.

Målsettingen for prosjektet var todelt:

- Prosjektet skal støtte kommunenes arbeid med å få til gode boligløsninger for deler av befolkningen som av ulike grunner har vanskeligheter med å komme inn på boligmarkedet.
- I tillegg ønsker vi å skape en virkelighetsnær læringsarena for elever i byggfagene og helse- og oppvekstfag ved videregående skoler, med fokus på utdannelse innenfor bygging av universelt utformede og energieffektive boliger.

En serie med fem workshops ble gjennomført i Namsos og Trondheim for å løse oppgavene knyttet til målsettingene.

Workshops

Trondheim	11.09.2014	Oppstart Overhalla bolig
Namsos	21.11.2014	Passivhusbygging, universell utforming og beboer-medvirkning
Namsos	09.06.2015	Oppsummering av oppgraderingsprosjektet
Namsos	14.09.2016	Oppstart ny gruppe byggfagelever
Trondheim	14.04.2016	Avslutning – Framtidens bygg

SINTEF, Olav Duun videregående skole, Overhalla kommune, Namsos kommune, Husbanken og lokal byggenæring har deltatt på workshopene. Representanter fra SINTEF og lærere og elever fra Olav Duun har også deltatt i møter, befaringer og praksisnær undervisning i Overhalla. Temaene for workshopene har vært oppgradering til passivhusnivå, universell utforming og beboermedvirkning. SINTEF har vært ansvarlig for å utarbeide det pedagogiske programmet. Lærere og elever fra Olav Duun har også presentert aktiviteter knyttet til oppgraderingsprosjektet.

Fem kursdager fant sted på strategiske tidspunkter i løpet av den toårige prosjektperioden. Den første kursdagen ga en innføring i passivhusteori og ble holdt i Trondheim før arbeidet på byggeplassen var påbegynt. Den andre kursdagen fant sted nær byggeplassen og fokuserte på teori om universell utforming og brukermedvirkning. Den tredje kursdagen, i juni 2015, var en avslutning og oppsummering for elever som skulle videre til lærlingplasser eller andre studieprogrammer. Hver kursdag hadde to deler. Den første delen inkluderte foredrag skreddersydd for både byggfag og helse- og oppvekstfag, og de to gruppene deltok på forelesningene sammen. I del to hadde byggfag og helse- og oppvekstfagene foredrag og aktiviteter, men temaene var fortsatt knyttet til boligoppgraderingen i Overhalla. Oppgraderingen av huset i Overhalla er et toårig prosjekt, men helse- og oppvekstfag var kun involvert det første året.

Bakgrunn

Eksisterende kommunale boliger er ofte feilplassert, har feil størrelse og form, og er dermed ikke tilpasset behovene til noen av brukergruppene (Narvestad, 2012). Overhalla kommune trenger boliger for vanskeligstilte. Kommunen har i dag få boliger til denne gruppen, og de boligene som er tilgjengelige har behov for rehabilitering. I Overhalla har målet vært å levere en boligoppgradering til passivhusnivå, med universell utforming, slik at boligen er tilpasset behovene til multihandikappede beboere. Overhalla ligger i Nord-Trøndelag og har en befolkning på ca. 3 700 innbyggere. Kommunen har en tradisjon for å bygge passivhus og har bygd flere hus og leiligheter på passivhusnivå. Nylig er det også ferdigstilt en barnehage på passivhusnivå. I samarbeid med Olav Duun videregående skole

har Overhalla kommune gjennomført sin første passivhusoppgradering. Olav Duun videregående skole har ca. 800 elever og ligger i Namsos, rundt 30 km fra byggeplassen i Overhalla. Prosjektet omfatter lærere og elever fra byggfag, elektrolinje, og helse- og oppvekstfag. Overhalla kommune har hatt tett samarbeid med elevene fra byggfag; prosjektleder for oppgraderingen jobber i teknisk avdeling i kommunen. Leder for helse og omsorg i Overhalla kommune var kontaktpersonen for elevene fra helse- og oppvekstfag.

Universell utforming og beboermestring i kommunale boliger

Norske boliger må møte de demografiske utfordringene knyttet til et raskt økende antall eldre innbyggere, de må redusere energibruken og de må være tilpasset kravene til beboere med ulike funksjonshemminger. Et overordnet mål er at alle, uavhengig av funksjonshemming, skal kunne leve i sine egne hjem så lenge som mulig, og det er planlagt at Norge skal være universelt utformet innen 2025 (Barne- og likestillingsdepartementet, 2009). For å få til dette må man bruke metoder knyttet til universell utforming som tar hensyn til beboernes egne behov og preferanser.

Figur 3: Fra presentasjonen "Universell utforming – hva er det?" 14.9.2015

Universell utforming er utforming av produkter og omgivelser på en måte som gjør at bruken i så stor utstrekning som mulig kan skje uten spesielle tilpasninger. Bruken av begrepet "universell utforming" er gitt forskjellig innhold av ulike tekniske og faglige tradisjoner, men en sentral del er en mer brukersentrert tilnærming til designprosessen. Ifølge livsløpsstandard er et hus tilpasset for rullestolbruker når han eller hun kan bruke bad, toalett, minst ett soverom, kjøkken og stue, og har tilgang til en gårdsplass og lagringsplass.[2] Disse aspektene er viktige for den generelle brukbarheten av en bolig, og er

[2] Livsløpsstandard skal sikre god tilgjengelighet utover de kravene som stilles i minstestandarden, slik at boligen kan brukes i alle perioder av livet, også ved nedsatt bevegelighet og bruk av rullestol. *HB 7.B.1.9 – Husbankens livsløpsstandard*

også nyttige for innbyggere som ikke har en funksjonshemming (Kjølle, et al., 2013). En universelt utformet bygning bør ikke stigmatisere brukeren – den bør bidra til å gjøre et hus til et hjem som er funksjonelt for alle. Den norske standarden NS 11001-2 angir et basisnivå for en bolig som sikrer tilgang og en høy grad av mobilitet. Lysstyrke, kontrast, akustikk og innemiljø er også inkludert, i tillegg til grunnleggende informasjon som tar sikte på å bedre forståelsen av temaene i forbindelse med funksjonshemminger: mobilitet, syn, hørsel, orientering, miljø/overfølsomhet (Standard Norge, 2009). Den brukersentrerte designprosessen har vært en viktig inspirasjonskilde for innholdet i kurset om beboermedvirkning i Overhalla.

Passivhusprosjektet i Åfjord inspirerte bruk av beboermedvirkningsmetoder i Overhalla. Husene i Åfjord har i dag multihandikappede beboere, og er et synlig resultat av samarbeidet mellom kommunen og den videregående skolen. Åfjord er et lite samfunn med litt mer enn 3 200 innbyggere. Elevene ble ikke spurt om de visste hvem som skulle bo i husene, men sjansen for at de visste dette vurderes som godt. Etter at prosjektet var ferdig, ble det foreslått at kunnskap om hvem som skulle bo i husene ville stimulere til økt forståelse av standarder og metoder som brukes til å bygge til passivhusnivå og få til universell utforming. I tillegg ville slik kunnskap støtte integrering av vanskeligstilte brukergrupper i samfunnet (Woods, Kjølle og Gullbrekken, 2013). SINTEF-teamet bestemte seg derfor for å legge mer vekt på universell utforming og beboermedvirkning i det pedagogiske programmet, og å involvere elevene fra helse- og oppvekstfag i Overhalla-prosjektet. Den tverrfaglige tilnærmingen skulle gi elevene innsikt i ulike sider ved prosjektet, og bringe elever sammen som ellers ikke ville hatt muligheten til å treffes.

Figur 4: Fra presentasjonen "Hva er en beboermedvirkningsprosess", 14.11.2014

Resultater fra samarbeid med elever i helse- og oppvekstfag

Gjennom prosjektet fikk elever fra helse- og oppvekstfag innsikt i etablerte metoder for å få fram brukerens behov og preferanser. Elevene fikk et eget sett av målsettinger som var knyttet til deres del av oppgraderingsprosessen.

Målsettinger

1. Gjennomføre en beboermedvirkningsprosess i Overhalla hvor erfaringer skal brukes i forbindelse med nye oppgraderinger eller under planlegging av nybygg
2. Opplæring av elever i vgs. om bygningens betydning for deres arbeidsdag i helse- og oppvekstsektoren og brukerens hverdag

Brukermedvirkningsprosessen som ble foreslått for elevene i helse- og oppvekstfag hadde to hoveddeler:

1. Gjennomføre en visuell kartlegging og befaringer

Elevene brukte befaringene som ble gjennomført under kurs og møtedager, samt dagen som gikk til den visuelle kartleggingen til å plassere brukeren i en bredere fysisk kontekst. Dette var relevant når intervjuene skulle gjennomføres.

2. Innhenting av data om brukernes behov i Overhalla blant både eksisterende og potensielle beboere, samt pårørende og helsepersonell

Lærere og elever fra Olav Duun jobbet sammen med SINTEF om utvikling av tre intervjuguider. De fikk feedback fra SINTEF underveis. To intervjuer ble gjennomført med tre brukergrupper: beboere, pårørende og ansatte. Hver gruppe hadde sin egen intervjuguide med åtte til ti spørsmål om preferanser og krav knyttet til nåværende og framtidige boliger.

Elevene evaluerte selv prosessen og presenterte resultater på workshopen 09.6.2015.

På grunn av de tre brukergruppenes ulike behov og roller er spørsmålene i intervjuguidene stort sett forskjellige. I noen tilfeller, der spørsmålene var like for alle tre brukergrupper, ble svarene fra intervjuene samlet i tabell for å sammenligne og presentere resultatene i en vitenskapelig artikkel (Woods og Gullbrekken, 2016). En av tabellene som ble lagd til artikkelen, er analysert og presentert i kortform i tabell 1. Tabellen vises her for å gi et eksempel på hvor grundig elevene har jobbet og kvaliteten på empirien som ble innsamlet.

Tabell 1: Utdrag fra resultatene fra intervjuene gjennomført av elever fra helse- og sosialfag. Spørsmål: *Hvordan ville drømmeboligen din vært?* (Woods og Gullbrekken, 2016)

Question: What do you think a dream home should include?		
Residents	Relatives	Employees
Bright colours, white ceiling. A lot of light. Flowers in the window. A garden table, large porch. Interesting views. I have no dream home – I'm fine where I live now. Large TV. No thresholds - easily accessible for wheelchairs. Good cupboard placement.	Large bathroom w/shower that is easy to exit. Wheelchair accessible rooms. Large hallway. Close to town centre. Central heating. Good lighting - automatic. A spare room for visitors. Low risk of fire. Nice walls with nice colours. A kitchen it is easy to cook in. Rooms without thresholds. Under-floor Heating. Close neighbours. Space for a clotheshorse in the hallway.	Large space. Large bathroom. Practical division of rooms. Their own porch. Regular weekly activities. A common room with social activities on Saturdays. Liked the design for the upgrade. Plenty of storage space. Good lighting. Nice pathways connecting neighbours. Living room and kitchen together. Normal homely kitchen. Close to fitness centre and shops. Easy access. Not too much furniture.

Spørsmålet i tabell 1 viser at selv om det er likheter i hva de ulike brukergruppene vil kreve av et hus, for eksempel en veranda eller rullestoltilgjengelighet, så er det variasjoner med hensyn til estetiske og funksjonelle kvaliteter. Beboere fokuserer mer på estetiske kvaliteter, mens ansatte legger størst vekt på funksjonalitet. Ansatte har også fokusert mer på den sosiale rammen rundt huset og på aktivitetstilbudet.

Ansatte fra Olav Duun videregående skole ga elevene i oppgave å analysere forholdet mellom målene for prosjektet *Overhalla bolig* og pensum for helse- og oppvekstfag, som har fokus på:
• Helsefremmende
• Yrkesutøvelse
• Kommunikasjon og samhandling

Elevene selv mente at det var en nær sammenheng mellom mål som presenteres i læreplanen og målene knyttet til prosjektet *Overhalla bolig*. For eksempel må elevene i henhold til læreplanen "Drøfte forholdet mellom levekår og livskvalitet" og "Forklare hva habilitering og rehabilitering er, og gi eksempler på forebyggende og helsefremmende tiltak". Elever uttalte at prosjektet hjalp dem å oppfylle kravene. I den interne evalueringen av prosjektet under workshopen 09.6.2015 uttalte elevene at de nå:

- vet mer om hvordan et intervju foregår
- vet mer om universell utforming
- vet mer om hvordan hele boligen bør være tilrettelagt for at brukeren kan fungere best mulig
- vet mer om beboermedvirkning
- har fått innblikk i tverrfaglig samarbeid

SINTEF har ikke gitt innspill til løsninger knyttet til universell utforming og heller ikke drøftet de valgte løsningene med kommunen eller videregående skole. Den universelle

utformingen ble definert av arkitekten Trønderplan AS. Løsningene er til en viss grad diskutert internt i SINTEF, men en større dialog under planleggingsprosessen hadde vært nyttig, særlig for elevene. Universell utforming har vært en viktig del av SINTEFs kursvirksomhet, og vi har forsøk å avmystifisere begrepet og forklare hvorfor det er relevant. Det var et ønske at tilbakemeldinger fra helse- og oppvekstfag skulle bli tatt med i oppgradering av nye hus i Overhalla kommune, men det har ikke skjedd. Dette kunne kanskje vært løst ved å åpne for dialog om hvilken rolle helse- og oppvekstfag skulle ha i prosjektet på et tidligere tidspunkt i utviklingen av boligene. Boligene i Overhalla har ikke vært evaluert. Det er ikke innhentet beboererfaringer knyttet til boligene. En evaluering av hele prosessen og de ferdige boligene hadde vært nyttig for Overhalla kommune, Olav Duun videregående skole og SINTEF.

Oppgradering til passivhusstandard

Figur 5: Opprinnelig boligplan øverst. Ny boligplan og perspektivtegning av boligen med tilbygg under. Lysbilde fra kursdag med SINTEF Byggforsk.

Et passivhus tilbyr en løsning for å senke energibruken, men de fleste eksisterende norske passivhus er bygd i løpet av de siste fem årene. En stor del av bygningene som samfunnet vil ha behov for om 100 år er allerede bygd. Hvis bygningene skal oppfylle kravene i etablerte energistandarder, vil de trenge oppgradering. Husbanken og Direktoratet for

byggekvalitet (DiBK) har begge signalisert at de ønsker en økt satsing på oppgradering eller rehabilitering av eksisterende boliger med høyt energiforbruk til lavenergi- eller passivhusnivå. Et passivhus er et hus som trenger mindre energi til oppvarming enn et vanlig hus. Energibehovet til oppvarming i et passivhus er ca. 25 % av oppvarmingsbehovet i et hus bygd i henhold til gjeldende byggteknisk forskrift. Kravene til passivhus i Norge framgår av NS 3700 (Standard Norge, 2013). For å oppnå lavt energiforbruk er bygningsskallet mer isolerende enn et vanlig hus. For å senke energibehovet må også ventilasjonssystemet være effektivt med hensyn til varmegjenvinning. Den norske passivhusstandarden NS 3700 inneholder også krav om lufttetthet av bygningen og krever testing av lufttetthet i den ferdige bygningen.

Tomannsboligen i Overhalla som var gjenstand for rehabilitering, er en typisk bolig fra 1970-tallet med følgende konstruksjoner:

Tabell 2: Opprinnelig konstruksjonsoppbygning

	Konstruksjonsoppbygning	U-verdi (W/m²K)
Gulv	Krypekjeller, stubbloft, 150 mm isolasjon	0,26
Vegg	Isolert bindingsverk, 100 mm isolasjon	0,39
Tak	Luftet, kaldt loft, 150 mm isolasjon	0,27
Vindu	Tolags isolerrute	3,0

Den geografiske plasseringen samt den begrensede størrelsen på boligen viste seg å være utfordrende for å tilfredsstille kravene til beregnet oppvarmingsbehov i henhold til NS 3700. Følgende spesifikasjon av bygningskroppen ble nødvendig.

Tabell 3: Oppgradert konstruksjon

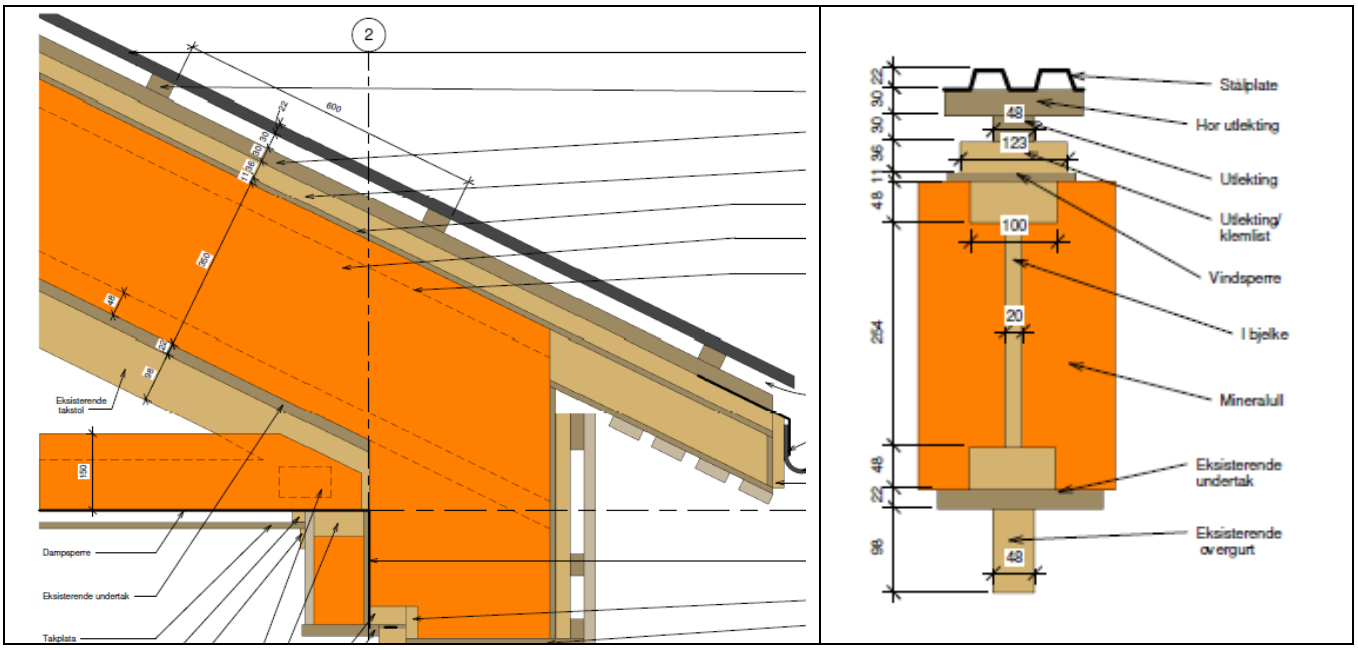
	Konstruksjonsoppbygning	U-verdi (W/m²K)
Gulv	400 mm isolert trebjelkelag, 400 mm løs lettklinker	0,06
Vegg	350 mm I-profiler montert utenpå eksisterende vegg, Totalt 450 mm isolasjon	0,10
Tak	Sperretak med 450 mm isolasjon, 150 mm isolasjon i himlingsplan	0,07
Vindu	Trelags passivhusvindu	0,80
Lekkasjetall		0,6 h^{-1}

Rehabiliteringsprosessen ble veldig omfattende. På grunn av kostnader ble det ikke valgt å bygge under telt.

Tak

Den opprinnelige takkonstruksjonen var et kaldt, luftet loft med taktro med asfalttakshingel som taktekning. I senere år er taket rehabilitert ved å montere ny opplektet platetekning oppå shingelen. For lettere å kunne forbedre lufttettheten i takkonstruksjonen, og lettere tilfredsstille kravene til lekkasjetall i NS 3700, ble det besluttet å bygge om loftet til et delvis oppvarmet, uluftet loft. For å kunne benytte loftsrommet til føring av ventilasjonskanaler ble det besluttet å legge 350 mm isolasjon i takplanet og 100 mm

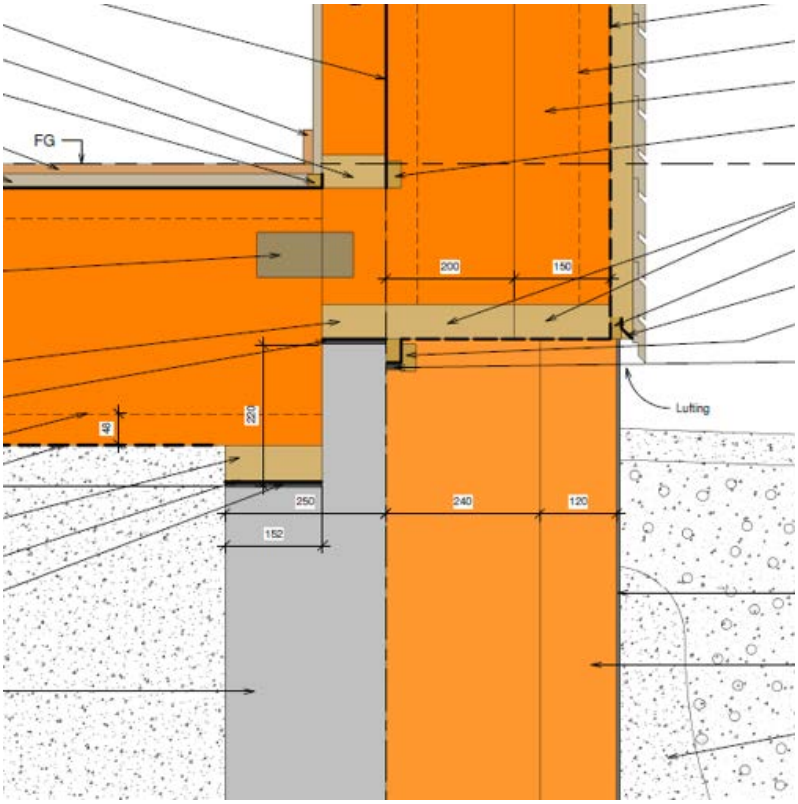
isolasjon i dekkeplanet, i stedet for å legge all isolasjonen i dekkeplanet. Denne løsningen er også fuktteknisk sikrere, siden mesteparten av temperaturfallet skjer på utsiden av eksisterende taktro. Takkonstruksjonen ble revet ned til taktro, det vil si at opplektet taktekning og shingel ble fjernet. Ny dampsperre ble montert på kald side av taktroa. Den videre byggeprosessen var avhengig av gode værforhold. Nye taksperrer ble montert på taktroa og isolert før kombinert undertak og vindsperre ble montert. Perioden fra montering av taksperrer til montering av undertak er svært kritisk med tanke på vær og nedbør. Dersom konstruksjonen blir oppfuktet, vil det ta lang tid før den tørker ut igjen via det dampåpne undertaket. Monteringen må derfor gjennomføres i oppholdsvær. Det vil også være nødvendig å dekke til mellom hver arbeidsdag.



Figur 6: Nye taksperrer med 350 mm høyde montert på eksisterende takkonstruksjon. Tegninger: Trønderplan AS

Vegg

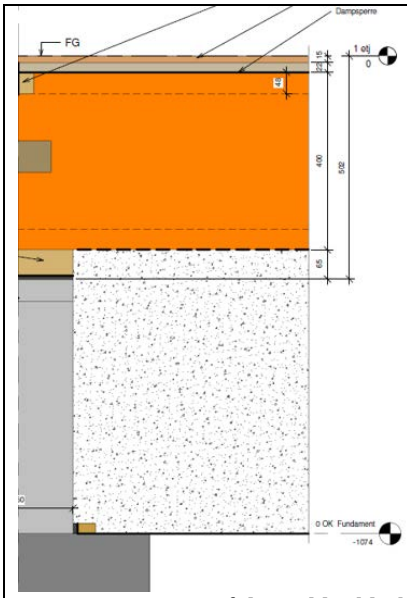
Eksisterende bindingsverksvegg med 100 mm isolasjonstykkelse ble revet ned til bindingsverket, kledning og gammel isolasjon ble fjernet. Ny dampsperre ble montert på kald side av eksisterende bindingsverk. Plasseringen gjorde det lettere å føre dampsperra kontinuerlig fra vegg til tak, og la samtidig opp til at elektriske føringer kunne legges i veggen uten å bryte dampsperresjiktet. Den nye bindingsverksveggen med 350 mm I-profiler er skrudd inn i den eksisterende bindingsverksrammen.



Figur 7: Vegg etterisolert med 350 mm I-profiler. Tegninger: Trønderplan AS

Gulv

Opprinnelig konstruksjon var en luftet krypekjeller med bjelkelag bygd som en stubbeloftskonstruksjon. Eksisterende trebjelkelag innvendig ble fjernet, radonsperre montert og tettet mot eksisterende ringmur. Kryperommet ble fylt med løs lettklinker før nytt, 400 mm tykt bjelkelag ble montert. Bjelkelaget ble isolert med innblåsingsisolasjon, se figur 8 og 9.



Figur 8. Kryperom fylt med lettklinker. Nytt bjelkelag med 400 mm tykkelse. Tegning: Trønderplan AS.

Figur 9. Innblåsing av isolasjon. Foto: Ståle Tranås

Vurderinger

En optimal rehabiliteringsprosess innebærer blant annet at minst mulig av den eksisterende konstruksjonen rives. Prinsippet er økonomisk gunstig samt at minst mulig riving medfører mindre arbeid, avfall og åpen værutsatt fase. Som en del av kursdagene ble de valgte rehabiliteringsløsningene drøftet med elever og lærere ved Olav Duun videregående skole. Følgende avsnitt beskriver vurderinger og mulige forbedringer av de valgte rehabiliteringsløsningene.

Tak

Rehabiliteringen i Overhalla var svært omfattende, og riveprosessen der opplektet taktekning og shingel ble fjernet medførte at konstruksjonen i en periode var eksponert for nedbørsfare før ny dampsperre ble montert. Byggeprosessen, med stor grad av plassbygging, medførte at den nye konstruksjonen var svært værutsatt, og det var begrensede muligheter for eventuell uttørking dersom konstruksjonen ble oppfuktet. En arbeids- og avfallsbesparende løsning hadde vært å beholde mer av den eksisterende takshingelen. Denne kunne tjent som dampsperre i det nye taket.

En mer robust byggeprosess kunne vært sikret ved å produsere takelementer i hall og så montere disse når været tillot det.

Vegg

Den opprinnelige veggkonstruksjonen ble revet ned til bindingsverket. Eksisterende kledning, vindsperre og isolasjon ble revet og levert til miljøstasjon. Dersom eksisterende vindsperre og isolasjon var uskadd, kunne man beholdt det og bygd ny vegg utenpå den eksisterende. Også i dette tilfellet er veggen svært værutsatt ved at ny bindingsverksvegg er eksponert for utvendig klima inntil vindsperre og kledning er montert.

Gulv

Gulvet var opprinnelig bygd opp som en luftet stubbeloftskonstruksjon. Eksisterende bjelkelag ble fjernet og det luftede kjellerrommet ble fylt med lettklinker. Et nytt 450 mm tykt bjelkelag ble montert med en liten luftespalte ned til lettklinkeren. Prosessen var svært arbeidskrevende, men ble valgt på grunn av ønske om bruk av trebjelkelag. En alternativ og muligens mer robust løsning ville vært å bruke EPS-isolasjon og støpt betongplate i stedet for trebjelkelaget.

Oppvarmingssystem

For å tilfredsstille kravene i NS 3700 må energibehovet tilsvarende 50 % av tappevannsbehovet dekkes av fornybare energikilder. I dette prosjektet er det valgt et felles solfangeranlegg for de to enhetene på totalt 10 m². Anlegget er dimensjonert for å levere 20 % av romoppvarmingen og 60 % av tappevannsbehovet, tilsammen omtrent 3 000 kWh/år.

I prosjektet ble det valgt et vannbåret varmedistribusjonsanlegg med bruk av gulvvarme i gang og bad. Eksisterende skorstein ble fjernet. I tillegg ble det valgt å benytte en radiator plassert i kjøkken/stue.

Oppsummering

Målsettingen for prosjektet har som nevnt innledningsvis vært todelt:

1. Å støtte kommunenes arbeid med å få til gode boligløsninger for deler av befolkningen som av ulike grunner har vanskeligheter med å komme inn på boligmarkedet

Prosjektet har vist hvordan kommunen kan oppgradere en eksisterende nedslitt kommunal bolig til passivhusnivå med full universell utforming. Boligene har en typisk konstruksjon for boliger bygd på 1970-tallet, og som det finnes flere av i Overhalla og i andre kommuner i Norge. Prosjektet kan dermed brukes som et utgangspunkt for lignende prosjekter når det gjelder oppgradering til passivhusnivå med universell utforming.

2. Å skape en virkelighetsnær læringsarena for elever i byggfagene og helse- og oppvekstfag ved videregående skoler, med fokus på utdannelse innenfor bygging av universelt utformede og energieffektive boliger.

Gjennom en serie på fem workshops har elever og lærere fått en praksisnær tilnærming til temaene passivhusbygging og oppgradering, universell utforming og beboermedvirkning. Kursdagene har funnet sted i tilknytning til aktivitet på byggeplassen.

Det som skiller prosjektet *Overhalla bolig* fra tidligere prosjekter med lignende ambisjoner (Åfjord-prosjektet og PAL-prosjektene) er den økte tverrfagligheten som oppsto ved å involvere elever fra helse- og oppvekstfag direkte i prosjektet. Gjennom prosjektet fikk disse elevene innsikt i etablerte metoder for å få fram beboernes behov og preferanser. I tillegg passet arbeidet med prosjektet godt inn i læringsplanen for helse- og oppvekstfag, hvor elevene blant annet skal "Drøfte forholdet mellom levekår og livskvalitet" og "Forklare hva habilitering og rehabilitering er, og gi eksempler på forebyggende og helsefremmende tiltak". Alle tre forhold kan knyttes til kvalitet i helsebygninger og boliger. Funksjonalitet i bygninger, estetiske kvaliteter og god planlegging under byggeprosess er blant faktorer som kan bidra til å løse problemstillinger knyttet til disse forholdene. Dette er faktorer som elevene fra helse- og oppvekstfag fikk innsikt i. I undervisning av elever ved helse- og oppvekstfag ved Olav Duun videregående skole har det tidligere vært lite fokus på hvordan bygninger kan påvirke disse forholdene. Gjennom kursdagene og aktivitetene knyttet til evaluering av eksisterende boliger og planene for framtidige boliger mente elevene selv at de fikk mer innsikt og hjelp til å løse problemstillinger knyttet til pensum. Dette er presentert av elevene under workshopen i Namsos i mai 2015. Ingen undersøkelse er gjennomført ved andre videregående skoler. Men det kan allikevel antas at elever ved flere videregående skoler vil ha nytte av opplæring i beboermedvirkning og i bygningens betydning for arbeidsforhold i helse- og oppvekstsektoren og brukerens hverdag.

Fokus på oppgradering er en annen faktor som skiller prosjektet *Overhalla bolig* fra tidligere prosjekter. Prosjektet har videre belyst ulike utfordringer ved de praktiske valgene som ble tatt gjennom oppgraderingsprosessen. Generelt vil plassbygging ved en såpass omfattende rehabilitering være utfordrende på grunn av vær. Bruk av telt er likevel ikke valgt på grunn av for store kostnader knyttet til leie. Prosjekter hvor skoler er involvert, trekker gjerne ut i tid sammenlignet med tilsvarende prosjekter gjennomført av en profesjonell aktør, noe som øker eventuelle teltkostnader. Et mulig alternativ er prefabrikkering i hall og værvarselplanlagt montering. En annen utfordring er størrelse på eksisterende bolig. Bygningen er liten, 123 m^2. Det skaper utfordringer når boligene skal tilpasses dagens krav til universell utforming. I Overhalla-prosjektet ble ingenting fra

opprinnelig grunnplan beholdt. Badet måtte bli større, boligen fikk en åpen løsning mellom kjøkken og stue. Det ble mindre gangarealer og lite lagringsplass inne i boligen. Et påbygg måtte bygges til lagring av beboernes utstyr, for eksempel rullestoler. Disse endringene har økt funksjonaliteten til boligen, og gir mulighet til at flere brukergrupper nå kan bo der.

Prosjektet var et prøveprosjekt. Nye løsninger har vært testet og det har vært en læringsarena for videregående skole. Oppgraderingen har dermed hatt stor nytteverdi. Det må likevel vurderes fra prosjekt til prosjekt om miljøgevinsten fra en omfattende oppgradering er stor nok i forhold til for eksempel utslippskrav når boligene er små i størrelse. Prosessen var også tidkrevende. Overhalla kommune planlegger ikke flere oppgraderingsprosjekter i samarbeid med videregående skole.

Oppgradering av alle typer bygninger, blant annet omsorgsboliger, vil være viktig i tiden framover. Energibruk i bygninger utgjør en stor del av dagens CO_2-utslipp. Byggenæringen har et ansvar for å bli mer bærekraftig, og en løsning er å bidra til å redusere energibruken ved å bygge energigjerrige bygninger, for eksempel passivhus. Den norske regjeringen har i stortingsmeldingen *Gode bygg for eit betre samfunn* indikert at alle nye hus skal oppfylle passivhusnivå fra 2015 (Kommunal- og regionaldepartementet, 2012). Byggebransjen setter nå mer fokus på å bygge til passivhusnivå, og på opplæring og rekruttering av arbeidskraft med kunnskap om passivhusbygging. Samtidig blir energikravene for nye bygninger stadig strengere, jf. byggteknisk forskrift. Den norske plan- og bygningsloven påpeker at klimaendringene vil påvirke plassering av bygninger og vilkårene som bygningene må tåle. Derfor kreves det nå at alle nye bygninger er tilpasset lokalklima (Standard Norge, 2010). EUs veikart foreslår at innen 2020 må alle nye bygninger være nesten nullenergi og svært materialeffektive. Det foreslås også at minst 2 % av den eksisterende bygningsmassen blir oppgradert per år på en kostnadseffektiv måte. I tillegg foreslår veikartet at 70 % av ikke-farlig bygge- og rivingsavfall skal gjenvinnes. Oppgradering av bygninger er dermed etterspurt og ønskelig både med hensyn til energiforbruk og universell utforming. Men fordi målet med å oppgradere er å få til en reduksjon i CO_2-utslipp, bør den potensielle miljøgevinsten ved et oppgraderingsprosjekt vurderes på forhånd. En omfattende oppgradering av en liten bolig kan by på utfordringer når det gjelder CO_2-utslipp.

Veien videre etter Overhalla boligoppgradering

Forskning på oppgradering eller rehabiliteringsprosesser er et satsingsområde for SINTEF. *SEOPP – Systematisk EnergiOPPgradering av småhus fra 1960–1990*, støttet av Norges forskningsråd, er et norskfinansiert eksempel på forskningsarbeidet. *Retrokit: toolboxes for systematic retrofitting* er et EU-støttet prosjekt. SINTEF har brukt erfaringer fra *Overhalla bolig* i flere prosjekter og har fortsatt prosjekter hvor erfaringene fra *Overhalla bolig* er nyttige.

Et tilsvarende rehabiliteringsprosjekt, støttet av Husbanken, ble påbegynt i Oppdal i 2015. Oppdal videregående skole oppgraderer i dette prosjektet en liten kommunal enebolig på ca. 80 m² til passivhusstandard med full universell utforming. Erfaringer og løsninger fra Overhalla-prosjektet ble selvsagt tatt med inn i Oppdalsprosjektet.

Husbanken-prosjektet *Oppgradering av gjenreisingsbebyggelsen i nord* handler om å ta vare på gjenreisningsarkitekturen i Nord-Troms og Finnmark og å oppgradere etterkrigstidens boliger til dagens nivå for energi- og livsløpsstandard.

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Ruth Woods, Lars Gullbrekken, SINTEF Building and Infrastructure, Trondheim

User Participation and Upgrading Municipal Housing in Partnership with Secondary Schools

In Overhalla, North Trøndelag, Norway, Secondary School pupils in collaboration with the local Municipality are upgrading two small housing units to passive-house standard. The houses will be homes for multi-handicapped members of the community. Norwegian municipalities require more social housing. Existing social housing is suffering from wear and tear, it needs to be adapted according to current universal design and energy efficiency standards, and meet the needs of today's residents. Small rural municipalities require affordable solutions to what is becoming an acute need for renovation. Solutions that ensure good housing quality and support the requirements of residents who have, for various reasons, difficulties in gaining access to the housing market. The paper presents a collaborative process where pupils from Health Care studies at Namsos Secondary School, were involved in the upgrading of the houses in Overhalla. The aim was to provide pupils with knowledge about how the physical environment can affect a user's everyday life and their own work in the health care sector. The paper will consider how successful the project was in achieving this aim[1]. These actions take place within a framework, which also considers the demands of the housing upgrade, including universal design, passive-house standards, the needs of the building studies pupils and the social dynamics found in a rural community.

The building of passive houses is still a relatively new phenomenon in Norway and upgrading to passive house standard is even less established within the building industry. This paper is based on the activities that are taking place within a two-year project known as "Overhalla Housing" which is funded by the Norwegian Housing Bank[2]. A primary aim of the project is to upgrade a semi-detached house from the 1970s and adapt it to the Norwegian Passive House Standard (NS 3700). Universal design is a requirement in current Norwegian building standards and the project therefore focuses on this issue, in addition, the intention is to involve future users of the house in order to ensure usability. Through collaboration with secondary schools the project aims provide the building industry with the skills and theory necessary to upgrade houses to the appropriate energy standard. The project team from SINTEF Building and Infrastructure has been involved in two previous projects, in small rural communities, where secondary school pupils have built new houses to passive house standard. Both of these projects included universal design, but there was no focus on user participation[3]. This is regarded as a missed opportunity by the project team. Health Care pupils therefore tested user participation methods as part of the work to establish a broader understanding of the physical environments influence on resident's everyday lives and their own working conditions.

[1] The activities associated with Building Studies pupils was presented in 2015 (Gullbrekken et al. 2015).

[2] Full name in Norwegian "Overhalla bolig: Rimelig oppgradering av kommunal bolig i samarbeid med videregående skole". In English "Overhalla Housing: low-cost upgrading of council housing in collaboration with a secondary school".

[3] Rimelige boliger for vanskeligstilte: fase 3, also known as the Åfjord Project (http://vassneset.blogg.no/) and the PAL project, organised by Sør-Trøndelag County Council involving 5 different communities and Secondary Schools.

There are good reasons for encouraging the building of passive houses. Buildings are responsible for a large part of Norwegian CO_2 emissions[4]. The building industry has therefore a responsibility to become more sustainable, and one solution is helping to reduce energy use by building passive houses. The Norwegian government has in the white paper *Good buildings for a better society* indicated that all new houses must fulfil passive house level from 2015 (Ministry of local government and regional development, 2012). The building sector has responded by placing more focus on building to passive house level and on the training and recruitment of a workforce with knowledge and skills about passive housing. A passive house provides a solution to lowering energy use, but most existing Norwegian passive houses are new houses, built within the last five years.

A large part of the buildings needed in a 100 years have already been built, both in urban and rural areas, if these buildings are to achieve established energy standards, they need upgrading. A building upgrade has similarities with rehabilitation and retrofitting, which all imply the addition of new technology or new features to older systems (Thuvander et al, 2012)[5]. The Norwegian Housing Bank and the Norwegian Building Authority have both indicated that they desire an increased focus on upgrading or rehabilitation to lower energy use or passive house level[6]. A passive house is a house that needs less energy for heating than a normal house. The energy demand for heating in a passive house is approximately 25 % of the heating demand of a house built according to the existing Norwegian regulations. The demands concerning passive houses in Norway are stated in the Norwegian Standard (Standard Norge, 2010). In order to achieve low energy use the building envelope is more insulated than an ordinary house. The windows panes have three layers of glass in order to lower the heat loss. To lower the energy demand the ventilation system also needs to be effective at heat recovery. The Norwegian Passive house standard NS 3700 also includes demands concerning the airtightness of the building and requires the testing of the air tightness in the finished building.

If Norwegian housing is to meet the demographic challenges associated with a rapidly rising number of elderly citizens then the existing housing stock not only need to reduce energy use, it also needs to be adapted to support the requirements of residents with different disabilities. The overall goal is that everyone independent of disability should be able to live in his or her own homes as long as possible, and it is planned that Norway will be universally designed by 2025 (BLD, 2009). All new buildings both public and private are to achieve a level of universal design, ensuring accessibility for all. Universal design is the design of products and surroundings in a way that allows their use by everyone, to as great a degree as possible, without special adaption or special design. The use of the term universal design has been given different content by different technical and academic traditions, but a central aspect

[4] www.zeb.no "Materialer i energi- og klimaregnskapet - Hvor viktig er det? Erfaringer fra forskningssenteret Zero Emission Buildings", 2016

[5] Thuvander 2012 also says there is no clear definition of upgrading or retrofitting as an action. Which indicates that it includes a large number of actions.

[6] http://www.husbanken.no/forbildeprosjekter/ http://www.dibk.no/no/Om_oss/

included by all is a more user-focused approach to the design process. According to the lifecycle standard, a house is suitable for wheelchair user when he or she can use the bathroom, toilet, at least one bedroom, kitchen and living room and have access to a patio and storage space. These aspects are also important to the overall usability of a residence and are useful to residents who do not have a disability (Kjølle, et al. 2013). A universally designed building should not stigmatise the user, it should help to make a home, one that is functional for all. The Norwegian Standard specifies a base level for housing and access to the residence, with detailed specifications that ensure a high degree of mobility. Brightness, contrast, directional, acoustics and the indoor environment are also included, in addition to basic information that aims to improve understanding of the themes associated with disabilities: mobility, sight, hearing, orientation, environment/ hypersensitivity (NS 11001-2, 2009).

In Norway, in both urban and rural areas, existing municipal owned housing is often misplaced, the wrong size and shape, and thus is not sufficiently adapted to the needs of different user groups (Narvestad, 2012). Overhalla Municipality also requires housing for the socially disadvantaged. There are currently few dwellings for this group in the community and the available housing is in need of rehabilitation. In Overhalla the aim is to deliver a high-quality housing upgrade which includes both passive house and universal design standards which suit the needs of multi-handicapped residents. Overhalla lies in Nord-Trøndelag County and has a population of approximately 3700 inhabitants. The community has already established a tradition for building passive houses. Overhalla Hus is a local building firm that in recent years has targeted the passive house market[7]. The community has now several new passive houses and apartments, and a recently completed nursery school with passive house standard. The municipality is currently planning an upgrade of the local health centre, nursing home and its sheltered housing. This project is also intended to achieve passive house standard. In collaboration with Olav Duun Secondary School, Overhalla Municipality is currently working on its first passive house upgrade. Olav Duun has approximately 800 pupils, and is located in Namsos around 30 km from the building site in Overhalla. The project includes teachers and pupils from Building Studies, Electrical, and Health Care Studies. Overhalla Municipality has a close collaboration with the Building Studies pupils; the project leader for the upgrade works in the technical department at the municipality. The head of the Department for Health Care at Overhalla Municipality was the contact for the Health Care pupils.

Secondary school pupils are the main on-site workforce in Overhalla. The use of secondary school pupils in building projects is based on the Blakstad model first tested in Froland Municipality in Aust-Agder County, a model further developed in Åfjord Municipality[8]. In partnership with Åfjord municipality, the Norwegian Housing Bank and BYGGOPP[9] and SINTEF, Åfjord Secondary School built a pilot project in Åfjord in 2012 (Woods, et al.,

[7] http://overhallahus.no/
[8] http://www.husbanken.no/miljo-energi/blakstadmodellen/
[9] The Building and Training Office in Sør-Trøndelag

2013)[10]. The inclusion of the Health Care studies pupils along with the building industries is a new aspect within this kind of project.

Universal design inspired methods

The project in Overhalla considers three areas that are, as mentioned earlier, important when upgrading homes in Norway today. These are energy standards, universal design and end user participation. The inclusion of these three areas has influenced the methods chosen and there is both a technological and social methodological focus. The focus of the paper is the social methodology that is influenced by universal design requirements, but the energy standards necessary to achieve a passive house upgrade provide a major driving force for the project and the work with Building Studies pupils is therefore briefly presented. The methods used with the Building Studies pupils have primarily been concerned with the educational program and providing expert guidance[11].

Figure 1: Pupils and teachers from Building Studies and Health Care Studies on the building site in Overhalla, January 2015

The educational program consists of five course days and where progression is closely associated with the needs of the building site and the secondary school calendar. In order to serve all of the needs, the project group at SINTEF developed a passive-house-upgrade educational program, where both teachers and pupils, and to some extent local entrepreneurs,

[10] Åfjord Municipality has so far built two passive houses, adapted to the needs of people with disabilities and is in the process of building an apartment building that is also social housing and will be built in collaboration with Åfjord Secondary School. (http://vassneset.blogg.no/). Sør-Trøndelag County Council has copied Åfjord model, and the teaching methods used and developed a number of similar collaboration projects in the rest of the county.
[11] During the Åfjord project, action research was used to following the response of the Building Studies pupils and a qualitative analysis was made of their actions and response (Woods et al, 2013).

learn about, and actually upgrade buildings to passive house level. During the construction process, teachers and local entrepreneurs gained expertise and pupils received practical training in the building of passive housing. Pupils have also experienced working in a team composed of specialists from different professional backgrounds from the construction industry.

The five course days have taken place at strategic times throughout the two-year project period. The first course day gave an introduction into passive house theory, and was held in Trondheim before work on the building site started. The second course day took place close to the building site and included theory about universal design and user participation. The third course day was in June 2015 and both concluded and summarized the preceding course days for Building Studies and Health Care pupils who had completed the course, and were moving on to apprenticeships or other educational programmes. Each course day had two parts. The first part included lectures tailor-made for both Building and Health care studies and the two groups attended the lectures together. In the section part, Building studies and Health Care studies were provided with their own specific lectures and activities, but where the theme was still connected to the housing upgrade in Overhalla. The upgrade of the two houses in Overhalla is a two-year project, but the health care studies were only involved in the first year of the upgrade[12].

The passive house project in Åfjord inspired the use of user participation methods in Overhalla. The two houses built in Åfjord are visible reminder to pupils and others involved in the project of work that took place. Åfjord is a small community with a little more than 3200 inhabitants. Pupils were not asked if they knew the members of the community would be living the two houses, but the chance of this is considered good. It was suggested that knowledge about who will be living in the houses in Åfjord would encourage greater understanding of the standards and methods used to build to passive house level and support integration of disadvantaged user groups into the community (Woods et al. 2013). Based on this conclusion, the SINTEF team decided to place more emphasis on the role of universal design, include user participation in the educational program and involve Health Care pupils in the Overhalla project. The multidisciplinary approach aimed to give pupils insight into different sides of the project, and allow pupils to meet when they otherwise would not have had the opportunity.

Data collection was qualitative and based primarily on presenting and testing methods for user participation and on the pupil's feedback. It therefore was part of the action research tradition, where researchers in collaboration with local actors generate solutions to actual problems in the social contexts (Kitchin and Tate, 2000; Meyer, 2001). In action research, the importance of learning and reflection are highlighted both for the “action researchers” and for the actors involved (Greenwood and Levin, 2007). In this case, pupils were provided with a condensed background of theory and concrete examples of how the methods could be used. They were then given a practical framework for implementation of methods and in collaboration with their teacher; these actions were implemented in Overhalla. The pupils themselves collected

[12] Two courses days were held for the new Building Studies pupils in the autumn 2015 and spring 2016.

data in Overhalla. They analysed the data and gave feedback about how well they considered the methods to have worked.

When working with the Health Care pupils the project aimed to achieve two things:

1. To teach Health Care pupils basic user participation methods.
2. To provide greater understanding of the impact of the physical environment on their working life, patient care and the quality of life of patients/ residents.

The two aims were inspired by needs of universal design and how this may be integrated into a housing upgrade. Universal design is "the design of products and environments in such a way that they can be used by all people, to the greatest extent possible, without the need for adaptation or specialized design." (Norwegian Ministry of the Environment, 2007). Universal design is primarily comprised of legislation and standards to be used in the design and planning of buildings and outdoor areas, and the standard has particular focus on the design of details. When used as a method during the design process it encourages greater emphasis on the end user. End users may be faced by numerous different challenges, include people in a variety of different age groups and needs may change over time. Therefore the use of universal design in the design process should be based on insight and understanding about different user perspectives (Vavik, 2009).

A Building Upgrade from a Social Point of View

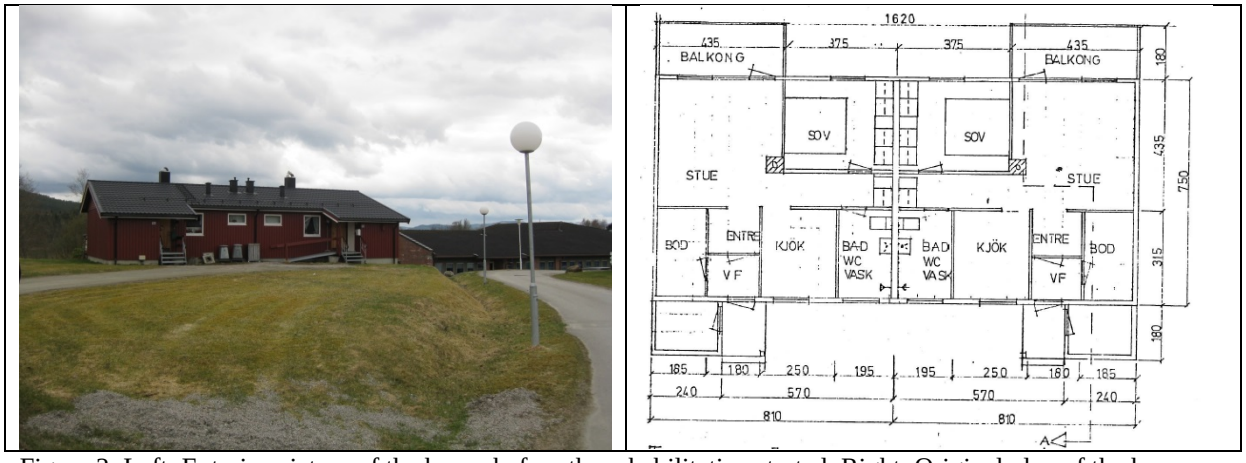

Figure 2: Left: Exterior picture of the house before the rehabilitation started. Right: Original plan of the house.

The original plan of the two housing units does not include universal design. Elderly members of the Overhalla community, who did not have serious disabilities, previously inhabited the two houses. The houses were not adapted to the needs of wheelchair-users and/or the visually impaired. In addition, to not allowing access to wheelchairs, or having space to manoeuvre wheelchair around the inside of the two houses, there was no space to store large equipment such as wheelchairs. When upgrading the house the municipality therefore needed to adapt the plan of the house to meet universal design standards. As a result of this the two houses have been given completely new floor plans, making the living spaces much more open-plan and an extension has been added that includes a common technical room for both houses,

storage space, porches outside each of the housing units and a ramp for wheelchair access. The plans for the upgrade were already in place before the Building Studies and Health Care studies pupils began their work on the upgrade.

Figure 3: Exterior and interior plans of the rehabilitated house. Trønderplan is the architect.

Universal design is often associated with meeting functional needs, wheelchair circles that secure bathroom accessibility, are a well-known example. However, a users' experience depends on both functional and aesthetic qualities, and on how the home and other kinds of the physical environments encourage a variety of uses (Høyland et al, 2013). Universal design can therefore actively combine the technical and social needs of the buildings. For example, lighting is an important aesthetic quality in a building and sensitive use of daylight and lighting systems support the use by visually impaired. The use of colour both indoors and outdoors has similar implications. It can help to guide a user through the space and/ or create a contrast which makes the space more legible for the visually impaired, as well as potentially more visually attractive.

Figure 3: The use of colour on outdoor ramps in Berg student town, Trondheim 2011

A physical structure is not a given it offers limitations and opportunities for its users, and the design of a space must consider all user needs. In Overhalla the pupil's project focused on resident needs because they were the ones who would be making the houses their home, but

there was also focus on care workers who had the houses as workplaces and relatives who were regular visitors. A home is also often a major source of identity, whilst also often being an idealised model and not a true picture of how people actually live (Munro & Madigan 1999). Contact with residents to establish their needs and preferences is recommended to avoid assumptions and mistakes during a design process. The use and understanding of a home that is established by a resident is often a negotiation between what is suggested by the physical space (the house) and the needs of the social space imposed by family life or other relational activities. The residents of the two housing units in Overhalla are expected to be single, but social interaction will still take place between relatives and health care workers. The design of the house should consider the relationship between the requirements of all three user-groups as well as their interaction together.

The pupils from health care studies will not all work in the health sector, some may move onto completely different careers, but they will all have some kind of working environment where the physical structure plays a role and can influence how well they able to do their job and their enjoyment of the working environment. They may even at some stage become involved in the planning of their working environment. Knowledge about how the physical environment can affect them and their co-users will therefore be useful whatever career they choose in the future. Lectures, workshops and dialogue between the pupils, the research group and teaching staff at Olav Duun was intended to encourage awareness. The pupils were asked to interview representatives from all three user-groups represented in the two housing units. By highlighting different user-needs, the pupils gain insight into a living and working environment, and in this way gain knowledge about what is acceptable and what is not acceptable. The intention was also that pupils would become aware that the physical environment is something they have influence over. It can be improved and by knowing this they will be able to take actions to improve it. Although they were unable to influence the current building upgrade, the intention was that feedback from the interviews would influence the design of future sheltered housing.

The Secondary School Pupils' implimentation of User participation methods

The projected aimed to test the usefulness of established user participation methods as part of a learning situation for secondary school pupils and to give Health Care pupils insight into the impact of the physical environment on their working situation. In association with these aims, the pupils were given their own set of aims, which were linked to their part in the building upgrade. These were:

1. Conducting a user participation process in Overhalla, where the insight will be used in conjunction with building upgrades or during the planning of new buildings in Overhalla.
2. An introduction to the importance of the built environment's role in their work in the health care sector and its implications for the user's everyday life.

The aims were intended to be motivational by providing the opportunity for pupils to make an impact on future building projects in Overhalla. The user participation process that was suggested to the Health Care pupils had two main parts:

1. Gathering data about user needs in Overhalla. This included existing and potential residents, as well as relatives and health care workers.

2. Following the building upgrade – through visual mapping, site visits and the aforementioned educational program.

The educational program has been described; this section focuses on data collection in Overhalla. Pupils were introduced, during the course days, to a number social science methods and examples from a SINTEF researcher's own fieldwork activity[13]. This also included a short introduction to the ethical challenges faced when working with qualitative methods. The methodological focus was on visual mapping and interviews. The methods chosen are easily explained and put into practice, and pupils were able to complete them without a large amount of help from teaching staff or researchers. The pupils worked in groups of two to three people and developed, with guidance from the SINTEF and the teaching staff at Olav Duun, interview guides for each of the three user-groups. The visual mapping took place during a daylong visit to Overhalla, where pupils visited the centre of Overhalla, the houses being upgraded, the nursing home and health care centre. Pupils were more nervous about the interview process, but because this took place in groups, none of the pupils were under pressure to do anything they were uncomfortable with. The more confident pupils lead the interview and the others observed or made notes and felt that they had also participated in the process. All the pupils stated afterwards that it had been a positive experience, they had been surprised by how friendly and open their informants had been.

The results from the visual mapping were less concrete than the results from the interviews. The visual mapping did not result directly in a presentation about the situation in Overhalla. The mapping day in Overhalla was however useful, it gave pupils useful insight into the physical context in Overhalla. For example the housing being upgrade is situated near a nursing home and nursing staff therefore have short way to travel in order to visit the residents. Previous visits had focused on the housing upgrade and a meeting in the Health Care Centre. The visit placed the user situation within a broader physical context, relevant when interviewing informants. Two interviews with each of the three user groups, residents, relatives and employees were completed. Each group had its own interview guide with eight to ten questions about preferences and requirements associated with present and future housing. Residents were for example asked:

"What is important for you to be contented where you live?"

The questions varied between the three interview guides, because of the different roles associated with the user groups, but a number of the questions were the same and a two of these are presented below. The results from the interviews influenced what the pupils

[13] A short introduction was given to action research, case studies and participant observation.

themselves thought was important when planning housing for individuals receiving help from the health care sector in Overhalla. Two Health Care pupils presented these results during the concluding course day in June 2015.

Question: What do you think a dream home should include?		
Residents	Relatives	Employees
Bright colours, white ceiling. A lot of light. Flowers in the window. A garden table, large porch. Interesting views. I have no dream home – I'm fine where I live now. Large TV. No thresholds - easily accessible for wheelchairs. Good cupboard placement.	Large bathroom w/shower that is easy to exit. Wheelchair accessible rooms. Large hallway. Close to town centre. Central heating. Good lighting - automatic. A spare room for visitors. Low risk of fire. Nice walls with nice colours. A kitchen it is easy to cook in. Rooms without thresholds. Under-floor Heating. Close neighbours. Space for a clotheshorse in the hallway.	Large space. Large bathroom. Practical division of rooms. Their own porch. Regular weekly activities. A common room with social activities on Saturdays. Liked the design for the upgrade. Plenty of storage space. Good lighting. Nice pathways connecting neighbours. Living room and kitchen together. Normal homely kitchen. Close to fitness centre and shops. Easy access. Not too much furniture.

Table 1: Excerpt from the results from the Health Care pupil interviews: *What do you think a dream home should include?*

The first example shows that although there are similarities in what the different user groups require of house, such as a porch or wheelchair accessibility. They also vary with regard to aesthetic and functional qualities, with residents focusing more on aesthetic qualities and employees having great focus on functionality. Employees also focused more on the social framework around the house and the need to provide residents with activities.

Question: What must be in place in the dwelling for the patient to feel safe?		
Resident	Relative	Employee
Feeling safe in current residence Can call staff when needed. The lock on the front door.	Good alarm system for the house. Security alarm for the resident. Able to lock the door. Non-slip surfaces in the bathroom. High toilet and something to hold onto. A secure stove - turns itself off. Employees close to the residence. Touch sensor to turn on the water on and off over a sink. Employees close by and quick to obtain. A common room for residents. Employees stop by every hour.	Fire alarm, security alarm. Employees nearby. To be able to see staff. Someone to call in case of accidents. A phone for those who can manage it.

Table 2: Excerpt from the results from the Health Care pupil interviews, *What must be in place in the dwelling for the patient to feel safe?*

In the second example, all three groups thought that the dwelling should be close to health care staff and that alarm systems should be in place. The relatives had in addition a long list of functional aspects that they believed would improve the security of relatives. All these aspects

are useful. This depth of interest was unexpected, and it points to the usefulness of interviews in highlighting a user perspective that otherwise may have been missed and could subsequently have been disappointed. Not all the questions brought forth so much detail about user requirements. This however does not mean the interview guides were not useful. There is general variation in the usefulness of questions in interview guides, this is not a particular problem associated with the guides developed by the Health Care pupils. Pupils developed their own interview guides with guidance from the research team. This helped the pupils to establish ownership to the questions and make them more comfortable in the interview situation.

An important part of the Overhalla Housing project is collaboration with the municipality. Overhalla Municipality is financing the building upgrade and collaborating closely with the Building Studies teachers and pupils. The project also collaborated with the Health Care Sector in the Municipality. The Head of the Department participated in the course days where the Health care pupils were participating and facilitated contact with informants within the three user groups in the community. Pupils were also invited to a meeting where the plans for the internal solutions within the house, particularly the kitchen and bathroom were discussed. The project leader for the building upgrade and the head of the Health Care sector in Overhalla were both present when the pupils presented the results from the user participation. The original intention was that the results would reach a broader group within the community, opportunities for achieving this were limited and this aim was therefore not achieved.

The pupils themselves and the research team from SINTEF evaluated the Overhalla housing project. As an extension of the activities connected to the housing upgrade in Overhalla, the staff from Olav Duun Secondary School gave the pupils the task of analysing the relationship between the objectives of the project and the Health Care curriculum. The pupil's analysis started with a comparison of the project aims and the aims associated with the health care curriculum, which are learning about:

- Health promotion
- Health care as an occupation
- Communication and collaboration

During a presentation of the results of this analysis in June 2015 a representative for the pupils stated that there was a close connection between the aims presented in the curriculum and the aims associated with the Overhalla Housing project. Pupils were for example according the curriculum required to "Discuss the relationship between living conditions and the quality of life" and "Explain what habilitation and rehabilitation is, and give examples of preventive and health promotion"[14]. Pupils stated that the project had supported them in fulfilling these requirements. The analysis served to further anchor the Overhalla Housing project as a part of their studies in general and not as a just extra workload. Pupils also completed an internal evaluation of the project, and stated in the feedback from the evaluation that they now:

[14] http://www.udir.no/kl06/HEA2-01

• know more about how an interview should take place
• know more about universal design
• know more about the planning of housing
• know more about resident participation
• have gained an insight into interdisciplinary collaboration, and about their time with the Building Studies pupils "*We have never spent so much time together before*".

SINTEF routinely evaluates all course days, and on the concluding course day, all the pupils received a short questionnaire. Nine Health Care pupils completed the questionnaire and all the feedback was positive. To the question, "*What do you think has been useful in "Overhalla housing" project?*" pupils responded:
"I learned a lot about performing interviews and communication and about the importance of passive housing and resident participation."
"Learned about universal design"
"We learned a lot of new things"
"Learning and knowledge about housing."

In sum, we can therefore suggest that the course had been successful. Importantly, pupils themselves believed that they had learned something useful.

Tentative Conclusions

The paper presents the collaborative process in Overhalla, between pupils from Health Care studies from Olav Duun Secondary School, Building Studies, Overhalla Municipality and SINTEF. The upgrade is based on the requirements of the community, which needs to improve the standard of the building stock available within the health sector. In addition, there are the needs of the Secondary School that requires practice based projects that offer an optimal situation by locating a large part of the educational activities outside the classroom. Building studies pupils are traditionally not happy about spending large amount of time in the classroom, but the practical part of their course work had traditionally been temporary, taking place in a construction hall or involving constructing a garage or shed. Health Care pupils also benefit from a school day with activities outside the classroom. Getting outside the classroom was however not the focus in the project for the Health Care pupils. The collaboration process and the use of user participation methods aimed to provide pupils with knowledge about how the physical environment can affect a user's everyday life and their own work in the health care sector. The usefulness of user participation methods in a learning situation for secondary school pupils is also at the centre of this analysis. Although the Health Care pupils themselves gave positive feedback about the Overhalla Housing project there were challenges. This section will consider successful the project was in achieving its aims and is analysed with regard to the aims presented to the pupils, and with regard to conducting this kind of project in association with a building upgrade in a small rural community.

1. Conducting a user participation process in Overhalla, where the insight will be used in conjunction with new upgrades or during the planning of new buildings.

It was never the intention that the pupils would be involved in activities connected to the current upgrading process. The aim was that the results from the user participation process would be used to provide insight when designing sheltered housing in the future in Overhalla. This has not been achieved, only the project leader for the upgrade and the head of the Health Care sector has seen the pupil's presentations. It was proposed that the pupils could present to the other municipal employees at a later stage, but when this was suggested during the autumn 2015 the pupils had already moved on in their education and it was not convenient for them to present the results. A top-down dissemination of information is not always conducive to effective communication. The information often remains at the top of the system without making an impact on those actually affected by the results (Pereira et al., 1993). The first aim was intended to be motivational for the pupils, giving them the opportunity to place their activities within as real-life context. It is now understood that the aim was too ambitious and that it should have been discussed with the teaching staff before the process. This would have potentially encouraged the establishment of a more manageable aim.

2. An introduction to the importance of the built environments importance to their work in the health care sector and to the user's everyday life.

This aim was, according to feedback from the pupils, more successful. However, it is unclear how deeply the established the knowledge is. The limitation in the time scale associated with the pupil's participation in the project, one year rather than two, is influential.

Universal design and user participation are part of the curriculum, the position of the Overhalla Housing project among both pupils and the Overhalla Municipality would have been strengthened if this factor had been emphasised at the start of the project.

A brief summary of the conclusions:
- Pupils have gained knowledge about how the physical environment can affect a user's everyday life and their own work in the health care sector.
- User participation methods, visual mapping and interviews, are useful within the educational setting of Health Care Studies. They are easy to use and relevant to the Secondary School curriculum.
- Pupils achieved contact with three different user groups, but the results from their analysis have not been feedback into the Overhalla community.

Overhalla is already a community at the forefront in the building of energy efficient housing, because for example the location of Overhalla Hus and the forward thinking attitude of the Municipal leadership. Its small size means that there a good lines of communication. However, the community's size also limits their capacity for including all those who will be affected by the renovation projects, this is particularly important for those working in the health care sector who because of limited human resources often receive their information from the leadership rather than by direct involvement. This can have implications for other

user groups who are dependent on employees within the health sector for their help and support. The collaboration with pupils from Health Care studies from Olav Duun Secondary School was successful in highlighting the role of the physical environment in the everyday lives of different user groups in the health care sector. Many of these pupils will in the future will work in the health sector in small communities. The knowledge they gathered will help them support the people that they are caring for and the project has provided them with insight into what they can demand in the future of their own working environment.

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Overhalla housing: Affordable retrofitting of municipal housing in partnership with Secondary Schools

1 Introduction

In Overhalla, a semi-detached house, with two small housing units, is being retrofitted to passive-house standard by Secondary School pupils in collaboration with the local Municipality. The houses will be homes for multi-handicapped members of the community. There is an increasing need for the upgrading of social housing in Norwegian municipalities. Houses are suffering from wear and tear, they need to be adapted to fit current universal design and energy efficiency requirements and they must meet the needs of today's residents. Municipalities require affordable solutions that ensure good housing quality and support the requirements of residents who have for varying reasons difficulties in gaining access to the housing market. When retrofitting to passive-house standard the main focus is often on the technical and economic implications for the building trade and residents, however social, functional and aesthetic qualities can affect long-term usability for residents. The paper is based on a two year project, financed by the Norwegian Housing Bank, which considers three main aspects; energy efficient retrofitting and universal design of municipal housing, training Secondary School pupils, and resident participation.

The building of passive houses is still a relatively new phenomenon in Norway, and the central focus within the project is providing the building industry with the skills and theory needed to build houses to the appropriate energy standard. Universal design is a requirement in current Norwegian building standards and the project also has focus on this issue, as well as providing for user needs through introduction of user participation methods. In order to serve all of these needs the project group at SINTEF Byggforsk developed a passive-house-retrofitting educational program, where both teachers and pupils learn about, and build energy efficient housing. Data collection has taken place in association with the program which consists of five course days and where progression is closely associated with the needs of the building site and the Secondary School calendar. The first course day gave an introduction into passive house theory, and was held before work at the building site was started. The second course day was more practical and was given close to the building site. The third course day will take place in June 2015 and will both conclude and summarize the preceding course days. In order to ensure continuity in the project two courses will be held for the students starting in the autumn 2015. Airtightness is amongst issues considered, which is critical in order to achieve Passive House standard.

The research question is how can small municipalities in collaboration with Secondary Schools retrofit existing municipal housing to be more energy efficient and universally designed homes, while addressing the needs of the residents? The retrofitting process in Overhalla is not completed. It is approximately half way. The paper will therefore present the processes so far involved, the challenges met and on occasion also solved.

2 Background

The aim of the project is to retrofit a house from the 1970s and adapt it to the Norwegian Passive House Standard (NS 3700), make it universally designed and at the same time involve future users of the house in order to ensure the usability of the house. Practical work on the building site is performed by pupils from the Olav Duun Secondary School in Namsos. This process is taking place within a background of theory, technical needs and other passive house projects, which is briefly presented below.

Most of the buildings that will exist a 100 years from now have already been built. In order to save energy many of these buildings need upgrading and retrofitting. Retrofitting encompasses terms such as rehabilitation and upgrading. All of the terms are commonly associated with buildings and imply the addition of new technology or new features to older systems, however there is no clear definition of it as an action and it is associated with a large number of related terms (Thuvander et al, 2012). Ebbert suggests that the term retrofit combines a number of expressions which suggest interference with the original building structure, such as restoration, renovation, maintenance, repair, refurbishment, conversion and transformation, in addition to gutting, extension, reconstruction, deconstruction and demolition (Ebbert, 2010). Retrofitting implies the repairing and making use of an existing building, as well as the adding of something that was not put into place during the original build, for example components such as an advanced ventilation system or solar panels. It suggests a major repair or change, whilst, for example, a refit is a minor improvement (Thuvander et al, 2012).

Most of the passive houses that exist in Norway are new houses, built within the last five years. It is however also possible to retrofit to passive house level. A passive house is a house which needs less energy for heating than a normal house. The energy demand for heating in a passive house is approximately 25 % of the heating demand of a house built according to the existing Norwegian regulations. The demands concerning passive houses in Norway are stated in the Norwegian Standard (Standard Norge, 2010). In order to achieve low energy use the building envelope is more insulated than an ordinary house. The windows panes have three layers of glass in order to lower the heat loss. To lower the energy demand the ventilation system also needs to be effective at heat recovery. The Norwegian Passive house standard NS 3700 also includes demands concerning the airtightness of the building and requires the testing of the air tightness in the finished building. The Norwegian government has through the white paper *Good buildings for a better society* indicated that all new houses must fulfil passive house level from 2015 (Ministry of local government and regional development, 2012). This has led to an increased focus on passive houses in the building sector. Passive houses provide a solution to lowering energy use and it is suggested provide a more sustainable housing solution than many previous Norwegian housing forms.

If Norwegian housing is to meet the demographic challenges associated with a rapidly rising number of elderly citizens then the existing housing stock should also be retrofitted to support needs of residents with different disabilities. The overall goal is that all kinds of citizens are

able to live in their homes as long as possible, and Norway should be universally designed by 2025 (BLD, 2009). The Norwegian government therefore requires the building of new housing to achieve a level of universal design. The principle of universal design in the design of modern buildings is to ensure accessibility for all. Universal design is the design of products and surroundings in a way which allows their use by everyone, to as great a degree as possible, without special adaption or special design. The use of the term universal design has been given different content by different technical and academic traditions, but a central aspect which they all include is a more user focused approach to the design process. Universal design aims to find solutions with a high degree of usability, solutions that encourage equality independent of people's differences. A consideration of different experiences and uses of buildings is an important strategy that encourages the development of improved solutions for more people. According to the lifecycle standard a house is suitable for wheelchair user when he or she can use the bathroom, toilet, at least one bedroom, kitchen and living room and have access to a patio and storage space. These aspects are also important to the overall usability of a residence, although only the main rooms will be available. (Kjølle, et al. 2013). The consideration of user design involves not only the needs of those who are physically disabled, but includes a number of other indicators that must be strived for and implemented as far as possible. The Norwegian Standard specifies a base level for housing and access to the residence, with detailed specifications that ensure a high degree of mobility. Brightness, contrast, directional, acoustics and the indoor environment are also included, in addition to basic information which is intended to improve understanding of the themes associated with disabilities: mobility, sight, hearing, orientation, environment/ hypersensitivity (NS 11001-2, 2009).

In Overhalla the aim is to deliver a high-quality housing retrofit, using high-school pupils as the main on-site workforce. Overhalla lies in Nord-Trøndelag County and has a population of approximately 3700 inhabitants. The community, like other Norwegian communities, also requires housing for the socially disadvantaged. Existing council housing is often misplaced, the wrong size and shape, and thus is not sufficiently adapted to the needs of different user groups (Narvestad, 2012). In Overhalla municipality there are few houses for the socially disadvantaged and the existing housing stock needs rehabilitation. Several new Passive Houses and apartments have been built in the community and a kinder garden with Passive House standard has recently been completed. The municipality is planning a retrofit of the local Health Centre. In collaboration with Olav Duun Secondary School Overhalla Municipality is working on its first passive house retrofitting project. Olav Duun has approximately 800 pupils, and is located in Namsos around 30 km from the building site in Overhalla. The project includes teachers and pupils from carpentry, electrical, and health and social studies. The Overhalla project has a background within a number of other Passive House building projects where secondary school pupils have been used as the on-site workforce. The inclusion of the health and social studies pupils along with the building industries is a new aspect within this kind of project,

The Passive-House project in Overhalla is based upon the Blakstad model tested in Froland Municipality in Aust-Agder County, a model further developed in Åfjord Municipality

(http://www.husbanken.no/miljo-energi/blakstadmodellen/). In partnership with Åfjord municipality, the Norwegian Housing Bank and BYGGOPP (The Building and Training Office in Sør-Trøndelag) Åfjord Secondary School managed within a short space of time to facilitate the start-up of a pilot project in Åfjord on the Vassneset site in 2012. SINTEF provided expert consulting during the planning phase, and developed a Passive House course, which was customized to simultaneously meet the needs of pupils, teachers and local entrepreneurs. During the construction process, teachers and local entrepreneurs gained expertise and pupils have received practical training in the building of passive housing. Pupils have also experienced working in a team (http://vassneset.blogg.no/) composed of specialists from different professional backgrounds from the construction industry. Åfjord Municipality has so far built two passive houses, adapted to the needs of people with disabilities and is in the process of building an apartment building which is also social housing and will be built in collaboration with Åfjord Secondary School. The project is considered a success by the school, Åfjord Muncipality and Sør-Trøndelag County Council, and the teaching methods used have been copied by Sør-Trøndelag County Council (Woods, et al., 2013).

3 Method

The retrofitting project in Overhalla considers three areas which are important when retrofitting or upgrading homes in Norway today. These are influenced by contemporary Norwegian building standards as well as building regulations. These are for example energy standards, in this case passive house, and universal design. In addition the project emphasises the importance of end users' and residents' participation when developing housing projects, particularly social housing where user needs are often quite demanding. The inclusion of these three areas has influenced the methods chosen. The project has therefore both a technological and social methodological focus.

The focus in this paper is the technical structure which is established by the demands of retrofitting to passive house standard and providing housing that supports the needs of all potential user groups, and therefore has a high standard of universal design. The paper will show that this has challenged the existing physical structure of the building, and the processes supporting the completion of the retrofit. The technical requirements of the building process are therefore the focus of this paper. The technical requirements are supporting the social needs of the future residents and retrofitting process takes place within the social framework provided by Overhalla Municipality and Olav Duun Secondary School, some of the data relating to this activity will also be presented. The methods used are therefore briefly presented below.

Methods used are participatory and action research, and in collaboration with local actors the intention is to generate solutions to actual problems in the social contexts associated with the retrofitting project (Kitchin and Tate, 2000; Meyer, 2001). In action research, the importance of learning and reflection are highlighted both for the “action researchers” and for the actors involved (Greenwood and Levin, 2007). A building process like the one in Overhalla fits well with Susman and Evered’s (1978) representation of the action research process as a cyclical process from (1) diagnosis, (2) planning of actions, (3) taking actions, (4) evaluation, and

finally (5), specifying learning and new knowledge. For example, at the end of each of the course days, pupils and teachers fill out a short evaluation form. In order to understand how and why the project in Overhalla has developed in the way it has, the project group and actors involved have participated in meetings and course days which provide the data to understand the wider social and technical implications of the retrofitting project.

4 Retrofitting process

Retrofitting implies the addition of new technology or new features to older systems, in this case a semi-detached house from ca. 1970. The existing physical structure provides a basis to build upon, and the aim is to provide high quality housing which will support the needs of a multi-handicapped member of the Overhalla community. The existing physical structure also provides limitations because it so much of it does not come near energy or universal design standards. The retrofitting process has therefore been extensive, changing the physical structure both inside and outside. Very little of the original building will remain when the retrofit is complete. The changes are described below in relation to three main areas, universal design, passive house and technical solutions; and are presented in terms of the technology and techniques used, as well as the challenges faced.

The semi-detached house has one floor with a total base area is 115 m². It is an element house constructed in the 1970s and was produced by the "Overhalla bolig"-factory. The house is situated near a nursing home and nursing staff therefore have short way to travel in order to visit the residents. The housing units originally housed elderly Overhalla residents without severe physical disabilities.

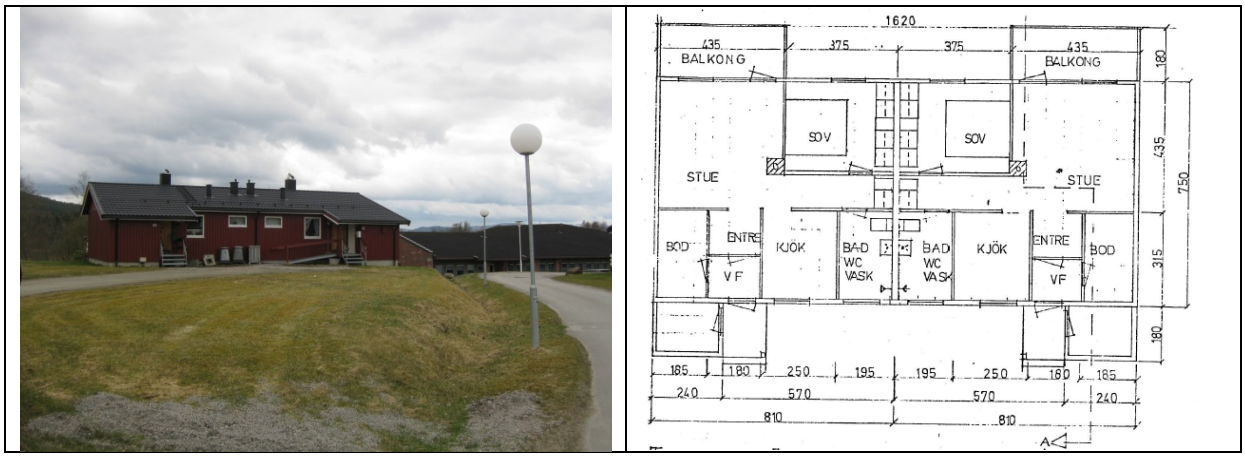

Figure 1: Left: Exterior picture of the house before the rehabilitation started. Right: Original plan of the house.

- Universal design

The original plan of the house does not include universal design. As previously mentioned, there is a need for houses adapted to universally design standards which can be used by for example wheelchair-users and/or the visually impaired. In addition to space to move the wheelchair around and inside the house, homes for wheel chair users need additional space to

store equipment such as wheelchairs etc. An extension of the building has been added including a common technical room and porches outside each of the housing units. When retrofitting the house the municipality therefore needed to adapt the plan of the house to meet universal design standards.

"Universal design is the design of products and environments in such a way that they can be used by all people, to the greatest extent possible, without the need for adaptation or specialized design." This quotation is the Norwegian Ministry of the Environment's definition from 2007. In relation to buildings and outdoor areas, universal design is primarily comprised of legislation and standards, and particularly focuses on the design of details. On the other hand, universal design may also be seen as a methodological approach to the design process and as such places greater emphasis on the end user. This should be based on insight and understanding about different user perspective (Vavik, 2009). It is important to understand that users' experiences depend on both functional and aesthetic qualities, but also on how the home and the physical environments invite to various use (Høyland et al, 2013). Universal design therefore actively combines the technical and social needs of the buildings where it is in place. The Norwegian Housing Bank due to the demographic challenges which are foreseen in relation to the Norwegian housing stock is supporting projects that are universally designed by offering cheap loans.

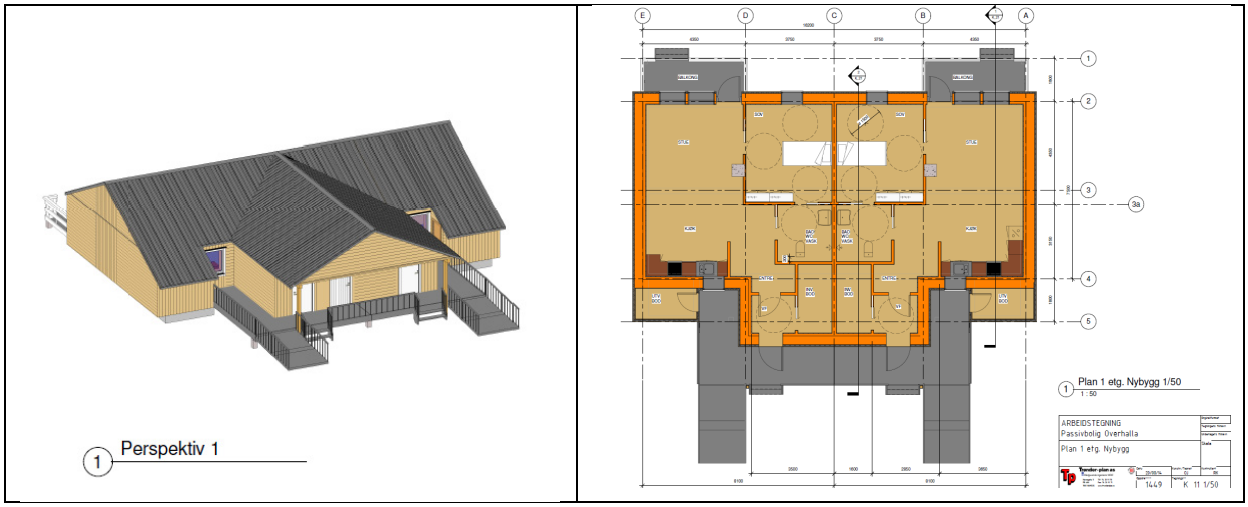

Figure 2: Exterior and interior plans of the rehabilitated house. Trønderplan is the architect.

- Passive houses

The municipality also aims to adapt the building to the Norwegian Passive house standard in addition to adapting the plans to meet universally design requirements. Originally the insulation thickness of the walls, roofs and floors was 98 mm, 198 mm and 198 mm respectively. The windows had two layers of glass. Rehabilitation to the Norwegian Passive House Standard (NS 3700) – level means adding a lot of insulation. In order to fulfil NS 3700 it was necessary to increase the insulation thickness by 350 mm in the wall, 400 mm in the roof and 200 mm in the floor.

Figure 3: Left: Demolition of the wall construction. Right: Construction of the new retrofitted wall construction.

In the autumn 2014 the retrofitting process was started. The walls of the house were stripped down to the original 98 mm wood frame, see Figure 3. The load bearing roof construction and the foundations were kept.

The construction process was performed without use of a tent. New studs and sills were mounted on the exterior side of the original wood frame as shown in Figure 3. This is an untraditional way of constructing walls making the building process very weather dependent. After the additional stud is mounted rain cannot be allowed to moisten the wood or the insulation before the insulation and wind barrier is mounted. This implies that construction only can be performed when it is not raining.

The floor-construction originally consisted of floor beams with insulated cavities. During the rehabilitation the floor beams was removed and new, thicker floor beams were installed. The roofing and battens were also removed from the roof construction, a new vapour barrier and new rafters were installed as seen in Figure 4.

Figure 4 Left: Mounting of roof rafter. Right: Weather proofing of the rafters in order to avoid moistening.

The new roof rafters are also vulnerable to moisture before the insulation is installed and the roofing underlay is mounted. As seen in the right picture in Figure 4 plastic foil was used to cover the wood rafters in order to avoid the new roof getting wet on rainy days.

The use of a tent to cover the house and protect it from the weather would have simplified the building process and made the building work less weather dependent. A tent was considered, but the cost was too high. The use of prefabricated elements both for the wall and roof construction is another measure which would make the building process less vulnerable to moisture and thereby increase moisture safety in addition to the efficiency of the project. This was considered, but the secondary school pupils needed as much onsite experience as possible and this became the deciding factor.

- Technical solutions

Originally each housing unit was heated by a wood stove in addition to electric radiators. The Passive House standard (NS 3700) demands that at least 50 % of the domestic water heating demand shall be covered by renewable energy, not direct electricity. The house's roof has a southern orientation with a low horizon and a solar collector system was chosen. An approximately 10 m² solar collector is planned installed on the south orientated side of the roof. The solar collector will be attached to a large hot water tank which will distribute hot water and heating to both housing units. A simple heating distribution system has been chosen with hot-water heating in the floors, in the porches and the bathrooms, in addition to one water-radiator in each of the living rooms. The original stoves and chimneys were removed as part of the retrofitting process.

5 Social processes

The retrofitting process is based on the requirements of the local community, which needs to improve the standard of the social housing building stock. In addition, there are the needs of the Secondary School which requires practice based projects which offer an optimal educational situation. Building and construction course pupils are traditionally not happy about spending large amount of time in the class room, but the practical part of their course work is often temporary and takes place in a construction hall or involves constructing a garage. The Åfjord project and the Blakstad model presented earlier have shown that these two independent needs can be effectively combined and provide communities with an enthusiastic labour force at a much lower cost than exists within the building industry at the moment. Pupils have been given the opportunity to work on real houses that will play an important role in communities where the pupils themselves often live and work. The local building industry also wins because they are provided with apprentices who are already well versed in the requirements of the Norwegian building standards and are knowledgeable about "future" ways of constructing homes.

Working in small communities and combining the resources of the local municipality and Secondary Schools, has been, as mentioned above, successful, but the successful combination of these social resources is not a given. Small communities may also be characterised by quarrelling and inefficiency, but this has not proved to be the case in Overhalla. There are short lines of communication within municipality administration and in the project. This has had a positive effect on the day to day running of the project and on-site activity. The site

manager for the retrofitting project works for Overhalla Municipality and there is a close collaboration between the site manager, the Secondary School and the teacher who is in charge of the carpentry course. The administrative model is different from the model used in Åfjord, where the teacher at the Åfjord Secondary School also acted as site manager in the project (Woods et.al. 2013). The "Åfjord-model" caused an extra strain on the teacher who was responsible for the management and logistics of the construction site, in addition to teaching duties.

The administration in the municipality is positive to the retrofitting and this factor in addition to the responsibility shown by the site manager has given the project a positive momentum. This is underlined by the site manager who is also positive with regard to involving the municipal administration. The municipality has a relatively small administration, but one which fulfils the needs of a small community. This encourages the aforementioned short lines of communication, something also experience when working in Åfjord. The chief municipal executive and the technical section leader both have construction backgrounds. They have shown particular interest into the Passive House- retrofitting project and have acted as driving forces in order to secure financing for the project and quick political approval within Overhalla Municipality.

An additional social process which is taking place in Overhalla is a user participation process involving teachers and pupils from health and social studies at Olav Duun Secondary School, as well as residents, relatives and health care workers associated with the social housing in Overhalla. The data from this part of the project is not yet available and it is as yet unclear how this process has influenced the retrofitting project and we have therefore chosen not to present results in the paper.

6 Further developments

The retrofitting project is extensive. The original house was stripped down both on the interior and exterior. Only the loadbearing structure of the house is left from the original 1970's semi-detached house. The process has resulted in a large amount of waste materials and possibly an unnecessary large amount of resources have been spent[1]. One way of saving materials would have been to keep the original floor- and wall construction. On the other hand one of the project's main goals is educational, and this has guided the choice of technical solutions. In some cases more material- and labour intensive solutions may be preferred for education reasons.

The climate in Central Norway is damp, with long periods of snow and rain during the autumn, winter and spring. The construction method chosen is weather dependent, and has affected the project progress. A lot of time has, for instance, been used to cover up the construction work taking place with tarpaulins, as shown in Figure 3. Insulation of the wall and roof construction could only be performed during dry periods.

[1]An overview of the resources used will not be available until the project is completed.

Use of prefabricated elements for the wall and roof construction would have been favourable in this project. The elements could have been produced in a construction hall (the Secondary School does have one) independent of the weather conditions. Mounting at the building site could have been well planned and performed during periods of dry weather. In the PAL-project where new passive houses are being built and where no retrofitting is taking place, all of the projects have used prefabricated elements constructed near the schools involved[2].

Pupils from Olav Duun have been given a good learning environment and they represent a cheap labour force for Overhalla Municipality, but using pupils as a work force also implies a prolonged construction period. Engaging a professional entrepreneur would have meant a much shorter construction period, approximately 6 months (the project in Overhalla is expected to take approximately 2 years). Increased construction time is expensive because of interest rates and cost, and the need to provide alternative housing for the inhabitants, in addition to lost income from rent.

7 Conclusions

The research question asks "how can small municipalities in collaboration with Secondary Schools retrofit existing municipal housing to be more energy efficient and universally designed homes, while addressing the needs of the residents?" The model presented in this paper does provide a solution to this question, by providing a cheaper labour force and engaging a team of local actors from Overhalla Municipality and Olav Duun Secondary School. The same model has proved has proved successful in Åfjord and Blakstad when producing new Passive Housing. The retrofitting of two housing units originally built in the 1970's is taking place and the focus is on providing energy efficient and universal designed homes. However the retrofitting process has not been completed and the final results cannot be presented in this paper.

The retrofitting project has high energy goals and few extensive retrofits to a Passive house level have so far been performed in Norway. However sustainability issues do arise when working with such an extensive retrofit and where so little of the original structure is retained. Only the foundations, the original studs and roof construction will be part of the house on completion. A new passive house could easily have been built on the same location and achieved the same level of sustainability.

However retrofitting the existing building stock is an important measure; a sustainable future rests to a large degree on making the best possible use of existing resources. The retrofitting project is an extreme example showing how far it is possible to go to achieve an energy efficient, universally designed retrofit. This was done to provide the best possible housing solution for a user group with extensive needs. The retrofit was also done to provide an optimal learning environment for pupils from Olav Duun Secondary School. The project is an

[2] PAL is a project organised by Sør-Trøndelag County Council and involves 5 different communities and Secondary Schools. The educational model is the same as the one established by the Blakstad model and Åfjord project. SINTEF Building and Infrastructure provided the initial teaching material.

important measure for recruitment of new manpower to local construction industry. It equips the pupils with the skills to meet all kinds of retrofitting challenges, as well as encouraging the youth in district communities to remain there and supply the local building industry with a skilled labour force instead of moving into the larger towns and cities and looking for other kinds of employment. Learning new skills and expanding the number of motivated craftsmen is vital if the building industry is to become increasingly sustainable. The social implications of this kind of retrofitting project are therefore extensive.

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Overhalla bolig: Rimelig oppgradering av kommunal bolig i samarbeid med videregående skole

Denne rapporten oppsummerer noen erfaringer fra prosjektet "Overhalla bolig: Rimelig oppgradering av kommunal bolig i samarbeid med videregående skole" hvor elever fra Olav Duun videregående var med på å oppgradere en eldre bolig. I prosjektet samarbeidet elever, kommunen, SINTEF Byggforsk og lokal byggenæring.

Fokus er temaer og metodikk i kursserien som SINTEF Byggforsk gjennomførte for elevene, i byggfag, elektro, og helse- og oppvekstfag. Rapporten drøfter prosessen fram mot oppgradering – både til passivhusnivå, universell utforming og beboermestring.

Overhalla kommune var prosjektleder for byggeprosjektet, og Trønderplan AS var ansvarlig arkitekt. SINTEF Byggforsk var engasjert gjennom et toårig prosjekt finansiert av Husbanken.

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